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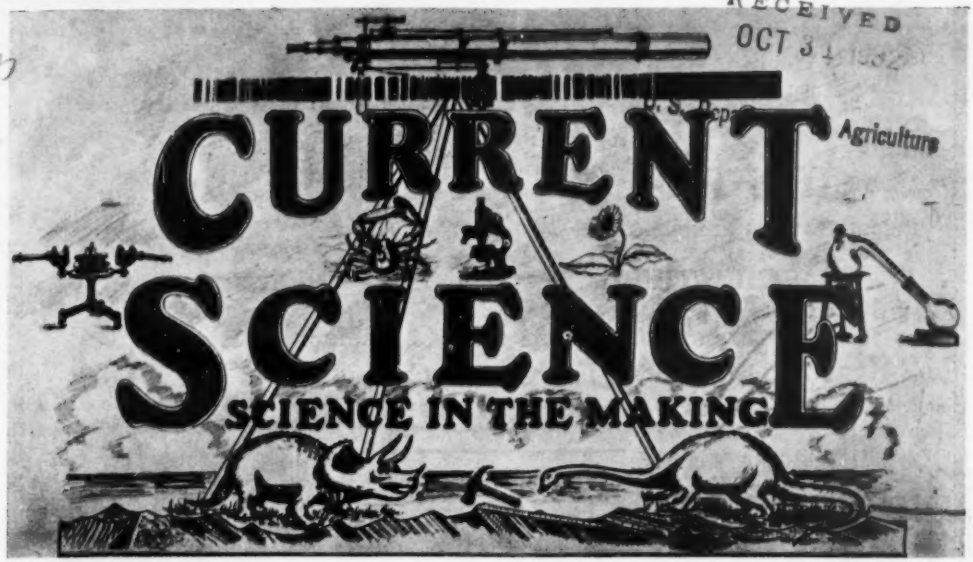

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CONTENTS

Science and Statesmanship.

IT may be presumed that the chief outcome of the political conferences which have already taken place and those about to be undertaken soon, will be the conferment of a large measure of autonomy on the provincial governments. The problem of utilization of this newly acquired freedom for the greatest benefit of India should now engage the closest attention of all the practical statesmen who have taken part in the deliberations of the Round Table Conferences. Few will dispute the truth of the statement that the noblest exercise of freedom is service to humanity, and perhaps the best equipment for this task is a general diffusion of scientific temper among the people and a severe discipline of Truth on the part of the statesmen. "Men little think how immorally they act in rashly meddling with what they do not understand. Their delusive good intention is no sort of excuse for their presumption. Those who truly mean well must be fearful of acting ill." These words o Burke ought to be engraved on the hearts of the politicians who wish to enter the portals of the new Indian legislatures and those of the statesmen who will control and direct the affairs of the State. If in 1914 they had been taken to heart or even remembered by politicians, it is reasonable to suppose that the world would not have witnessed the appalling catastrophies nor been subjected to a long train of apparently incurable economic miseries.

A mechanized mind and a vague apprehension of the power of science for saving and destroying human life do not constitute the type of mental equipment for dealing with the fortunes and the precious human lives of a whole country. Science was not given to man to be prostituted for destructive purposes and its high ideal was envisaged in the impassioned sentiments expressed by Sir C. V. Raman in the concluding portion of his Dacca Convocation address. He said, "the true justification of science lay in its success in opening out a new vision of the Universe, in giving us an insight into the origin and development of human life, and in fact, in its enabling man to perceive himself in his proper relation to the Universe he lived in. The progress of the human race would depend on the success attained in applying the methods of science to the study and control of human activities

in all their varieties. Science was opening out new vistas of thought, was creating a new religion and a new philosophy which would replace beliefs which were not founded on demonstrable truth but were merely vestiges of man's animal ancestry." In the Introduction to his *Democracy and Liberty*, Lecky says that, "the whole great field of modern scientific discovery seemed out of the range of even such a scholar and statesman as Gladstone" and Gregory records an interesting interview between this eminent politician and Faraday who, when in the midst of explaining an important discovery of his, was superciliously interrupted by the remark, "But, after all, what use is it?" administered an appropriate rebuke, "Why, sir, there is every probability that you will soon be able to tax it." It is true that no scheme of government can be conceived in which taxation of human activities can be dispensed with as a superfluity, but it is in the method of its application that the higher visions of statesmen are called into exercise. We are only labouring the most obvious thing when we state that the best part of the revenues must be devoted to the promotion and extension of those activities from which they are derived, to the contribution of the moral and material progress, to the elevation of the racial standards and to the creation of a new and better world. If these objects were to come within the province of practical politics, they are not likely to be achieved by minds imbued with a mild spirit of diplomatic curiosity, a hopeful outlook that things will somehow right themselves in the end, a moderate egotism and an extraordinary capacity for making interminable speeches. The last is a fatal gift which Froude has rightly characterized as, "the harlot of the arts". Our new legislatures should not be permitted to become a paradise of half-baked politicians or a sporting ground of mechanized statesmen.

The constitutional reforms about to be introduced into Indian legislature, will, we think, have to be worked on the basis that politics though inexact is still a science, for, "The material of politics is human nature, its motives honourable and base, its appetite for power and for service, its passions, its prejudices, its memories and aspirations." Very many harsh things have been said, to our mind most unjustifiably, about politicians and politics and their services to the country are apt to be forgotten the moment the causes which called for their exertions, cease to exist. Mr. Baldwin in his Rectorial Address to the University of Edinburgh quotes from that eminent historian and divine, Dr. Figgis, the following passage:—

"In regard to truth, the more one reads of man's notions, about the meaning and method of civil society, the more often is one inclined in despair to say that truth has little to do with politics as it has with politicians."

But by far the hardest thing ever said of the politician is the following, "To the low types which the human race has produced from Cain down to Tartuffe, the age of Democracy has added a new one—the politician." This evil reputation, which few politicians merit, is almost entirely due to the fact that truthfulness prevails less in politics than in the world of science and force is resorted to by the politician for sefety of the State which may involve the suspension of the accepted code of morals, and finally the policy of administration is not based on any fixed laws or principles of science, but permitted to alter in accordance with the creeds of the party in power. When a policy has to be defended, the politician relies more on his persuasive powers of oratory than on his capacity to prove its validity. It is just here that the politician and the scientist part company; but if the scientist were made a statesman, would he adopt politics of the kind where, "a lower standard of habitual truthfulness is alleged to prevail than in the world of science"? Possibly he may introduce the methods of science into statecraft and after all the difference cannot be too wide to keep them separate, with prejudice at any rate to the latter.

One of the hardest problems which the reformed constitution will have to deal with and provide a satisfactory solution for, is the labour question which in India, as elsewhere, is intimately bound up with the country's economic condition and the nature and extent of unemployment among the community. Labour is essentially a scientific problem, almost as exact as any of the physical sciences and unemployment is the result of an unscientific handling of the growth of civil society, the occupations of its members and the correlation of both with the produce of the land. It is obvious that the task of settling labour in anything approaching satisfaction and permanence may seem almost impossible for the reason that human society is a growing organism whose needs

are governed by a complex set of factors. In the investigation of this problem alone, possibly an expert knowledge of more than half a dozen sciences will have to be impressed. An expert knowledge, unassisted by a trained imagination is practically of little importance even in purely administrative functions and in them as well as in carrying on high matters of diplomacy and politics, what the statesmen need are the insight, inspiration and visions which the discipline of science confers. Such a statesman will realise that the preservation of the State is just as much his concern as its enrichment and observe that in economic conflicts and international jealousies the chances of amicable and permanent settlements will be jeopardized if the ardour of patriotism were permitted to outstrip the appreciation of natural laws. We can cajole nature, and even conquer her, but cannot abuse her with impunity. It is in the teachings of science, both physical and biological, that the statesmen will have to find inspiration and infer lessons for their profession of politics and the services of expert scientists, instead of being confined to the laboratory and lecture rooms, should be associated in ever-increasing measure with all the branches of political and administrative functions. Inactivity is comparatively innocuous, but activity without insight must be a destructive force in any calling and is fraught with incalculable danger, especially in politics. The fate and fortune of millions of people cannot eternally be treated as a game of chance in which probability of success is determined by the wealth of rhetoric; but politics, by assuming the definite character of a distinctive branch of a biological science, should pass into the custody of scientist statesman.

The application of the methods of science to the administrative problems which are primarily concerned with the life and affairs of restricted geographical areas, must eventually contribute to the general progress of the people as a whole. Certain departments of the public service such as education, agriculture, medicine, engineering and forestry, are scientific in their needs and purposes, and only men who have actually lived these sciences can visualize the power and possibilities which they hold for making human life richer, happier and fuller. The administrator in charge of these and allied departments needs all the resources and knowledge which an intensive scientific training has imparted to him and his interest in the scientific problems must lead him to organise and supervise research laboratories. Moreover a scientist who has himself engaged in the investigation of special problems in research laboratories would, in certain respects, make a more competent administrator of these special departments in which his expert knowledge and his powers of organization would be of inestimable value in controlling and directing their affairs satisfactorily and efficiently. It is not in the scientific departments alone that men with wide scientific experience of teaching and research are required, but in almost every conceivable branch of administration there is need of the application of scientific methods in the treatment of general and special problems which have anything to do with the management of human activities on any scale. It is true that men and their affairs cannot be dealt with as chemical substances in the laboratories and the test-tube and mortar may not be the instruments of administration or of the transaction of high political matters. Though the means of investigations may differ, the form of procedure must be scientific, consisting of observation, analysis, verification and deduction of general laws. But this is not our position. The whole government machinery must breathe a scientific spirit, and administrators must possess an attitude of mind which seeks to justify not by faith in creeds and undemonstrable theories but by verification of evidence. Statesmen have fallen into the common mistake of classifying things and thoughts as scientific and political, but the position of the man of science is that there are no scientific subjects and scientific thoughts implying topics and ideas about scientific matters but, "the subject of science is the human universe" embracing not only the facts and phenomena of this universe, but "everything that is or has been or may be related to man". The qualities therefore that go to make the scientific mind are precisely the attributes that go to make the statesman's mind, for the "nature of both must be one which vibrates in unison with that of which it is in search".

The main concern of statesmen must be the orderly progress of the human race and it is possible of attainment only by imparting to the men and affairs of the government a scientific outlook, attitude

and method. Progress, if it is to be real and permanent, must spring from the hearts of the people and the function of statesmen must be to provide the means of stimulating and directing it for the greatest common good. In the reformed administration of the country, where it is proposed to introduce adult franchise, we really wonder whether the education of the people has been of such a character as to enable the general electorate to make the right selection, to weigh between two opposing political issues, or to formulate clearly their public duties and obligations. The primary want of the people which is a condition precedent to their general progress is a wider diffusion of scientific education which would also include a knowledge of those branches of learning, leading to a practical appreciation of an enlightened and well-ordered social and political life, the observance of the laws of public health and principle of hygiene, the inculcation of the deeper meaning and purpose of humanity and the ideals of the higher values of individual and corporate life. In order to secure the attainment of these objects in any measure, the reform of education, the revision of medical ethics and alteration of the complexion of administration should form the immediate consideration of the reformed government. It seems to us that what political philosophy has not succeeded in achieving for mankind, science may yet fulfil.

Unemployment in India.

WE have received a copy of the booklet by Sir M. Visvesvaraya, K.C.I.E., LL.D., on "*Unemployment in India*," which formed the subject of a public address delivered in Bangalore on the 8th September. The address commences with a critical examination of the present economic situation in India, and contains an analysis of the causes which have led to the unemployment among the general masses of the people and among the educated community. It will be remembered that the Government of India in their circular, after having enumerated the causes which have contributed to the serious state of unemployment on an extensive scale, practically gave up the case as being far too complex to admit an easy or immediate solution. A public pronouncement, setting forth suggestions of practical remedies for relieving the tension of the situation, by a distinguished and resposible citizen, with wide administrative experience and knowledge of practical affairs of men and things, must possess, at the present moment, more than ordinary interest. Our main object in announcing the publication of this important booklet is to focus the attention of the public in general, and of the authorities and men of science in particular, on what may commonly be called the burning topic of the day. We intend to return to this in the next issue of *Current Science* when we expect to be able to deal with the subject from standpoints other than those already examined by us in the editorial for the August Number.

Waterfalls as Habitats of Animals.*

By Dr. Sunder Lal Hora, D.Sc., F.R.S.E., F.L.S., F.Z.S., F.A.S.B.,
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IN an earlier paper (1) the animals of the bed of a rapid flowing, shallow, rocky stream were divided into two "sub-associations" and each of these was again divided into three "strata". Further work on the ecology of the torrential streams has made it clear that the habitats should be classified into still finer divisions in order to realize the full significance of animal adaptations, *e.g.*, the correlation of an animal organization with its habitat. So long as the varying gradations in

*Published with the permission of the Superintendent, Zoological Survey of India.

A short account of waterfalls as habitats of animals is given by Pearse in *Animal Ecology*, p. 194, New York, 1926.

a particular environment are not thoroughly understood, the finer adjustments of the animals to their respective external conditions cannot be grasped. It has already been indicated (2) that a portion of a small stream can be classified according to the strength of the current and the nature of the substratum. It was then pointed out that the animal associations vary in accordance with the nature of these factors in an apparently similar environment. Following this line of research I have now subjected waterfalls to an intensive study, and have been greatly struck by the diverse associations of animals that inhabit this perilous situation. By a waterfall I do not mean only the spout of water that falls, but I include in it the vertical cliff of rock, the black pool at its base and the neighbouring parts of the gorge that receive a spray from the waterfalls. Thus defined, a waterfall can usually be divided into the following possible habitats of animals:—

1. Water spout.
2. Lip of waterfall.
3. Vertical rock behind the spout and not directly influenced by the current.
4. Usually habitat 3 is replaced by a slanting or vertical rock over which the water flows.
5. Rocks at the base of waterfall over which water crashes.
6. Rocks at the edge of the current intermittently splashed with the eddies of the turbulent waters.
7. Rocks in the neighbourhood of waterfalls which receive a constant spray of water.
8. Deep pool at the base of waterfall.

Even a casual consideration of this classification will show that the conditions of life in different situations must be different, and consequently, the association of animals inhabiting each division must also be different. It may, however, be indicated that there are no hard and fast limits, and that where the habitats grade into one another, the animal associations also overlap one another. I shall now define the possible divisions of waterfalls in terms of ecological factors.

The waterspout lacks solid substratum and in the column of falling water there are no permanent inhabitants, but occasionally fish, such as salmon, mahseer, etc., when ascending streams for the purpose of spawning leap through waterfalls. Large waterfalls or cataracts, however, form effective barriers for the ascent of even these muscular fishes.

The existence of animals on the lips of waterfalls must seem very precarious. It has, however, been shown (1) that the lips of waterfalls can be divided into two categories ecologically, those in which the rocks are covered with vegetation and those in which the rocks are bare. Vegetation, besides affording shelter, provides a secure substratum which enables animals to cling to it by means of hooking devices. On a bare rock much firmer grip is required for stability of movement, and consequently the fauna is relatively poorer. Blepharocerid larvæ (Diptera) and nymphs of *Iron* and *Baetis* (Ephemeroptera) are found on bare rocks, while among vegation the fauna is much richer and varied, and mainly consists of the torpedo-shaped clinging larvæ of Diptera, Plecoptera and Ephemeroptera. According to the strength of the current, the fauna varies considerably in this habitat.

The vertical face of rock behind the column of falling water, but not affected by it, is a place of safety for several kinds of insects, watermites and other small animals. The mosses that grow in this situation afford protection and substratum for anchorage to a number of small organisms. There are certain species of birds that make nests in this habitat. The fauna here varies with the amount of moisture available, and if there is a regular flow of water over the rock (as in habitat 4), fishes may be observed sucking their way up the cliff.

Sometimes the falling column of water flows over smooth, slanting rocks and in such cases the nature of the fauna depends upon the rapidity of the current. If the current is not very fast Caddis-worms of several types are found, but in swift waters Blepharocerid and *Simulium* (Diptera) larvæ abound. Fishes, such as *Garra*, and tadpoles, as those of *Rana afghana*, are also found climbing upstream in this habitat.

The animals that live at the base of a waterfall must be able to withstand a tremendous crash of water. I have collected chiton-like larvæ of the Blepharoceridæ at the base of small falls. It is presumed that the chiton-shape of these larvæ enables them to take the firmest possible hold. The only other animals that were found in this situation were the pupæ of Caddis-flies, but they occurred on the sides of stones and not

on their upper surfaces over which the water fell. According to Dodds (3), the nymphs of *Bœtis bicaudatus* live on rocks where water pours upon them with considerable force.

The rocks in the immediate neighbourhood of the current constitute a very important habitat in this environment, for they afford places of safety for the pupæ of insects and also provide substratum to the adults for egg-laying. In this situation the animals are less liable to be swept away by the current, though they are kept moist by an intermittent splashing or by the dribbling of water from the lip of a waterfall. From here the larvæ migrate into swifter waters, and the pupæ can let out the adults in comparative safety.

The rocks at a little distance away from the waterfall are kept moist by a spray. A large number of moisture-loving animals live in this habitat, but the most striking are the larvæ and pupæ of Psychodidæ which were very common in streams round about Tista Bridge below Darjeeling. These insects live on bare rocks and their earlier stages resemble those of the Blepharoceridæ superficially. Some interesting Copepods have been collected from among mosses. The fauna varies according to the nature of the substratum in this habitat.

The fauna of a pool at the base of a waterfall is very different. The water does not flow very rapidly in it, but it is highly oxygenated. Migratory and other fishes are found in it. Frogs, insects and their larvæ, leeches, molluscs, etc., are all found in these pools.

From the above it is clear that the habitats of animals are as specific as the characters of the species, and probably equally difficult to define. Though our knowledge of the classification of animals has made great progress, unfortunately our knowledge of their habits and habitats is very meagre. It is generally conceded at the present time that "Structural modifications shown to be adapted to particular habitats or modes of life seem to be more characteristic of genera or groups of higher ranks than of species" (4). Generally speaking, the factors strength of current, nature of substratum, amount of moisture, etc., used above for classifying waterfalls, influence groups of animals and mould them to similar lines. Possibly the finer gradations of these factors distinguish species. As an illustration we may take the three species of *Bœtis* described by Dodds (3 & 5) from Colorado living on rocks in swift currents. *B. tricaudatus* with three caudal cerci lives in currents flowing at the rate of 5 feet per second. *B. intermedius* in which the middle caudal cercus is decidedly shorter, lives in waters flowing as much as 8 feet per second and finally *B. bicaudatus*, in which the middle cercus is represented by a vestige only, lives in places where the water flows at the rate of 10 feet per second.

The reduction of the middle cercus (as well as the modification in the shape of the posterior part of the body) can thus be correlated with the increased swiftness of the current and the modification is useful in imparting to the animal perfect stream lines. It is clear, therefore, that minute differences between species, when studied ecologically, can be correlated with the *intensities* of certain factors in their environments.

The study of Animal Ecology is growing in importance, and it is reasonable to expect that some international standards of the classification of habitats and of nomenclature will be fixed before long to save the new branch of science from the fate that has overtaken Taxonomy.

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South Indian Neolithic Culture.

By M. D. Raghavan, B.A., D.A. (Oxon.), F.R.A.I.

THE sources of information from which Man's early culture history may be elucidated are mainly two-fold. On the one hand, there are the actual relics of antiquity, whose relative position in the chronological sequence is determined by their position in the deposits in which they are found, and by their associations. On the other hand, there are important data to be derived from the study of the living races and peoples who have continued in a condition of arrested culture,—such are the Bushmen, the Australians, the American Indians etc., whose conditions of life afford examples of persistence of Stone Age conditions into modern times—the first is the archæological and the second the ethnological method of investigation.

The recognized divisions of time before the existence of historical records are named after the principal materials used for the manufacture of tools, weapons and utensils; and the Stone Age which preceded the use of any metal is now sub-divided into periods or phases, and named generally after type, stations or localities where the particular industry is best represented. Thus considered there are three main divisions:—Eolithic or dawn of Stone Age, Palæolithic or Old Stone Age and Neolithic or New Stone Age.

Researches into the prehistoric archæology of Europe show that early Palæolithic man made implements having a thick wedge-shaped edge tapering to a point with a heavy rounded butt opposite, which must have been held in the hand and used for hacking or chopping. This is now generally known as a 'hand-axe', which is a free translation of the French name, *coup-de-poing*. The next step forward is marked by implements of broad ovate form in which the cutting edge extends all round and the tool is more symmetrically shaped. Some of these sharp rimmed implements may have been hafted for use as axes or knives, but this can only be conjectured. No remains whatever have been found of the hafts of these Palæolithic implements. Assuming that the handles were invariably of wood, it is not surprising that most of them should have perished without leaving any trace. No undoubted modern implements of these types are known, and they were not made by Neolithic man.

Rude implements of quartzite found in very great abundance all over South India bear marked resemblance to, and are identical with, the European forms of hand axes referred to above, and evidently relate to a period of culture strictly conformable with the Palæolithic culture of Europe. While the implements of the Palæolithic peoples of Europe passed through various stages of development evidencing a chronological sequence of comparatively well-established culture phases leading to the distinctive culture of the Neolithic age, the course of transition has not been so clearly traced in India, so that the hiatus between the Palæolithic and the Neolithic ages is much more emphasized and is left largely unfilled.

In the Palæolithic age, stone implements were never ground or polished, whereas Neolithic implements were frequently ground or polished. But the reason for its tardy appearance is as obscure as its origin, seeing that there was nothing to prevent the men of the old Stone Age, particularly in Europe, from treating flint in this way as they had treated bone tools. It is now thought that the new method reached Western Europe at the same time as the idea of building dolmens over the dead; and most of the implements finished by this means are axe heads generally called 'celts'. This term is derived from a latin word supposed to mean 'chisel', and has nothing to do with the people called Celts or Kelts.

While the working part of the Palæolithic hand-axe was the point and the side edge all around, the butt being simply for grasping, in the celt the broad butt has become the sharp business end, the point is of secondary importance and the side edges are no longer used. The celt is usually used mounted at right angles in a wooden handle and used like a modern axe. A celt is thus an axe-head of hard stone with a cutting edge at the broad end, a butt more or less pointed, the sides or edges in nearly straight lines both in the side and front views, the whole or part being finished by grinding after being chipped into shape.

These stone axes are, no doubt, the best known implements of the Neolithic age, and they are also the most widely distributed products of the Stone Age in other parts of the world. Their shapes vary within somewhat narrow limits, but they all agree in having a broad cutting edge, the butt-end being usually blunt. Some of them are roughly shaped by mere flaking and they may belong

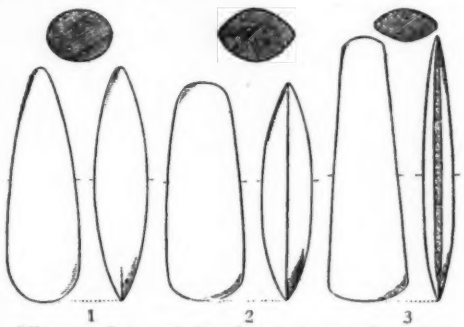
to a period previous to the introduction or discovery of methods of grinding and polishing. Some unpolished implements are no doubt unfinished specimens.

Speaking generally, four stages may be discerned in the manufacture of a Neolithic celt. In the initial stage we get an implement which is roughly chipped into shape. In the next stage, the implement is advanced a stage by 'pecking', *i.e.*, breaking down the angles of the different chippings with a sharp pointed instrument with the object of decreasing the quantity of material. In the third stage, the implement is ground and all excessive roughness removed, and in the final stage, the ground surface is polished. The implement is thus complete and is ready for hafting.

In making an implement from a block of stone, a stone hammer was used for striking blows to reduce the stone to proper form. In the manufacture of the larger implements a suitable block was chosen and brought into shape by a succession of blows, each blow removing a portion of the stone. The implement was thus the 'core' or the central part of the stone, the flakes removed being either discarded or, if suitable in shape, used for making into smaller implements such as scrapers, knives and spear heads.

Methods of grinding and polishing were no doubt of later origin than the processes of battering, pecking or flaking. In Europe, the hardness of the favourite material flint would delay or prevent the discovery that an implement might often be most easily finished by rubbing it on a suitable piece of rock. In India the stones were more easily worked, and lent themselves more readily to grinding and polishing. It is probable that the art of grinding and polishing was introduced into Europe from the East. As to the methods of grinding and polishing little need be said. A fixed grind stone in the form of a slab of rock has been widely used, such as the rock surfaces discovered in the Bellary District by Mr. Bruce Foote, on which well-polished grooves had been worn by grinding the celts to a sharp edge. Similar grooves were found in other localities in South India. Smaller whet stones have also been widely used for both grinding and polishing. The extreme degree of polish on some stone implements is an evidence of great pains spent in the process. It may be that the polishing of stone implements was in the first case the result of the observation that implements in frequent use acquired a polish especially at the cutting edge.

Most of the stones are less easily flaked than flint. Quartzite is particularly refractory and the flaking is difficult to control. Quartz is still worse in this respect and lends itself very badly to being chipped into any shape, for which reason it was very rarely used by the South Indian Palæolithic peoples. With the change in the method of working tools and weapons came an equally great change in the material the Neolithic people selected. Instead of the light-coloured quartzite chosen by the Palæolithic people, the South Indian Neolithic men chose rocks of superior toughness and tenacity such as trapoid rocks, diorite, basalt etc.



The variety of implements produced by the Neolithic people is also much greater than that made by the Palæolithic people. In the celt group several varieties have been distinguished. Three of the best known types are illustrated in the order in which they are thought to have been made: (1) A primitive form with a pointed butt, a cutting edge of oval outline and an oval cross section approaching a circle. (2) The butt becomes blunt and then broad, while the curve of the cutting edge is reduced, and the cross section becomes an oval sometimes pointed at both ends as the sides are sharpened. (3) The next important stage is the thin butted celt which has a sharpened butt (like a second cutting edge), an oblong section due to the sides being ground flat, and a cutting edge with slight curve approaching a straight line. While the pointed butt is more commonly met with in South India, the sequence is continued by several other varieties. One of the most interesting types is the broad and thin celt foreshadowing the earliest type of iron axes which differ from all the rest. There is the battle axe type of

celt which is short and thick. A rare and aberrant form is a thin celt with its sides bevelled almost to a sharp edge.

The word celt is often applied to implements of the type of adze heads or chisels. Modern stone axes of Neolithic type have been found in many parts of the world, and specimens from the Pacific Islands, America and other regions are often practically identical with the celts of the Neolithic Age. The axe or adze is the most important tool of wood-working peoples, since it is essential for the procuring and shaping of material for huts, canoes and other wooden structures. Implements of this form have been used in primitive agricultural works and some of them may be regarded as hoe-blades. It is often impossible to decide whether a given stone celt was used as an axe-head, an adze-head or as a chisel. The adze-head which is adapted for attachment to a haft in the same way as the axe-head, but with the edge of the blade transverse to the line of the haft, may be distinguished from an axe-head by the fact that one of the faces in the adze is bevelled off at the edge. The chisel has a wedge-shaped edge and is usually narrower than either axe- or adze-head.

The prehistoric localities discovered in South India unmistakably show that the Stone Age peoples were widely distributed over the country with the exception of the mountainous and forest regions of the West Coast where few relics have been found of these ancient races. Their distribution seems to have been considerably influenced by the accessibility of the materials suitable for their implements. Thus numerous settlements of the Palæolithic race have been formed within the bounds of the quartzite-yielding districts of Chingleput, North Arcot and Nellore than elsewhere in South India. The Kistna river becomes the northern boundary of these peoples, their traces getting less the further north we go. The Palar river similarly forms the southern boundary. Neolithic remains are most numerous in the northern parts of the Deccan plateau, where materials for their implements are more plentiful. Few traces of them exist south of the Cauvery.

The chief centre of the Neolithic peoples in South India was Bellary where many settlements have been discovered. The first discovery of any Neolithic celt in India was made in this district in 1872 by William Fraser. This was followed by a systematic survey of the district by Bruce Foote disclosing several Neolithic settlements. Shevaroy hills in the Salem district are also rich in Neolithic implements and other relics of a civilization rooted in the depths of time, such as the megalithic monuments. Neolithic sites have also been discovered in Kurnool, Guntur, Anantapur and Cuddapah districts and in several localities in Hyderabad State.

The first appearance of pottery occurs in Neolithic Age. Yet no place has been met with in South India where the making of vessels has been carried on on a large scale. Typical Neolithic pottery is dull coloured and rough in shape with little decoration beyond impressed or incised patterns, as distinguished from Iron Age pottery, with its better polish and finish and brighter colour.

In the Neolithic Age we also get indications of the domestication of animals. This implies that Neolithic man was largely pastoral, with a food supply rendered more or less constant by domestication. The increase in sedentary habits had an inevitable tendency for the people to group themselves in communities. And with aggregation in communities, it was no longer essential for each individual to be self-supporting. With this tendency, progress in agriculture was rapid.

Towards the close of the Neolithic Age we get the first evidence of the use of metals. While archæological discoveries in other lands disclose a Bronze Age prior to the Iron Age, in India there is nothing to warrant us to put forward such a claim in favour of bronze, the prehistoric peoples of India having obviously passed directly from the use of stone to the use of iron, as is clear from the iron implements excavated from the prehistoric burials in South India, though the process was necessarily very slow. Prehistoric men no doubt began to use iron as they had used stone, not recognizing it as iron but as something harder than stone and better adapted for making into implements. The earliest iron implements were no doubt mere copies in iron of the Neolithic celt.

In the next stage of prehistoric culture the art of smelting and working iron was introduced and gave it the name of the Early Iron Age. The much greater ease and rapidity with which weapons and tools of greatly improved quality could be produced in iron, led to the making of stone implements to be gradually abandoned.

Bruce Foote's account of the Bellary Hill

Settlement shows that in South India the Iron Age followed hard on the Neolithic Age, remains of the two phases of culture occurring in the same sites. It is evident that in a very large number of cases the Iron Age people must have occupied the old Neolithic sites, and celts and other stone implements are found mixed up with the highly polished and bright coloured Iron Age pottery, as has been found at the ancient village site of Pati at Peddamudiyam village in Cuddapah district excavated by the Archæological Survey in 1905. The site has been successively occupied by peoples in varying stages of civilization from prehistoric to modern, and finds of Neolithic stone implements, pottery, implements in iron, stone lingams, bronze rings and gold coins and ornments have been found, including a small find as recent as February last. From the evidence afforded by several such ancient sites in the districts of Deccan and in Mysore, it is very reasonable to conclude that the iron workers were the direct successors of the Neolithic people.

The Neolithic and Iron Age peoples constructed megalithic monuments such as the dolmens and stone circles which are found in various parts of South India. They are found on the Palni hills in the Madura district, on the Shevaroy hills in Salem district, on the Nilgiri hills, in Coimbatore, Malabar, Coorg, Hyderabad and elsewhere. It is observed that the distribution of megalithic monuments agrees with that of the Neolithic and Iron Age sites. This association combined with the Neolithic and Iron Age remains met with in these tombs enable us to conclude that these graves were constructed by these early races. These megalithic structures afford evidence of a relatively high social organization and of a well-developed religious cult.

The interest manifested in the study of the early chapters in the story of Man's Culture is steadily increasing, and there are now but few regions which remain totally unexplored for traces of early Man and of his activities. It is, however, a sad reflection that South India is of all parts of the globe, about the least explored region, though there is evidence of its having been populated by very ancient races in the dim distant past, and shows in its present primitive population cultural contact and racial linking with the primitive races of Indonesia, Melanesia and Polynesia. Bruce Foote's investigations have not been followed up by any excavations of prehistoric sites, and it is to be hoped that the several administrations responsible for the Government of the different parts of South India, and the learned bodies, such as the Universities, will wake up to the great need for exploring the prehistoric archæology of South India.

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The Affinities of Chætognatha.

By C. C. John, D.Sc., D.I.C. (London).

SOME of the observations on the anatomy and development of the Chætognatha seem to be of importance in throwing light on the systematic position of the group. Various authors have assigned it to widely different phyla taking into consideration certain sets of characters in support of their individual views. As all these theories have been reviewed by Burfield,* it is proposed at present to deal with only some of the more accepted views put forward by Huxley,† Doncaster‡ and Patten.§ Huxley was the first to state definitely that the Chætognatha shows a great deal of resemblance with Annelida; and later this view has been emphasized by Hertwig¶ and others. In support of this view it was pointed out that as in Polygordius the spacious body cavity of the trunk is divided by a longitudinal septum, which supports

*Burfield, S. T., "Sagitta," *L. M. B. C. Memoir*, 1927.

† Huxley, T. H. "Observations on the genus Sagitta," *Brit. Ass. Report*, Vol. XXI, 1852.

‡ Doncaster, L., "On the development of Sagitta, with Notes on the Anatomy of the Adult," *Quart. Journal Micr. Sci.*, Vol. XLVI, 1902.

§ Patten, W., *The Evolution of Vertebrates and their Kin*, Churchill, London, 1912.

¶ Hertwig, O., "Die Chætognathen," *Jen. Zeitschrift*, XIV, 1880.

the alimentary canal. There are four bands of striped longitudinal muscles which show a pinnate arrangement of the fibres. The ventral ganglion corresponds to the ventral nerve cords of Polygordius, the body is divided into three segments by two transverse septa, one in the region of the neck and the other behind the anus, and the prehensile spines are similar in structure and formation to the Chætopd setæ, which, however, are absent in Polygordius. These facts have been considered sufficient reasons for associating Chætognatha with Annelids. On this Annelidan theory the Chætognatha are three-segmented Annelids, which having adopted a swimming mode of life are greatly modified from the true Annelidan type.

Against this assumption it has been argued that the apparent similarities are only superficial and so do not indicate the true affinities of the group. The importance of metameric segmentation in deciding the affinities of the group is denied by Doncaster, who points out that it arises in various ways independently in different groups. Further, it is stated that the absence of nephridia, vascular system and oblique septa, greatly weakens the supposed resemblance and that the Chætognatha and the Annelida differ fundamentally in their types of development. In Annelida the mesoderm originates from pole cells whereas in Sagitta it develops from the anterior folds of the archenteron. Though the embryonic development is so greatly abbreviated to be of any importance in helping to solve the problem of its affinities, Doncaster emphasizes the absence of any stage which resembles the trochophore, as a deciding factor against this theory. The transverse septa arise by the meeting and fusion of the somatic and splanchnic mesoderm, so that the three divisions of the body which result from these are not similar to the annelidan segments nor are they homologous with one another. The further difference between the two groups concerns chiefly with the structure and disposition of the trunk muscles. They are arranged in four longitudinal rows and the muscle fibres consist of an outer contractile portion adjoining the basement membrane and an inner nucleated protoplasmic part forming a continuous lining of the trunk and tail coelom. This structure recalls the condition found in Nematoda and in this direction, therefore, Doncaster tried to discover the relationship of the group. According to him the oviduct of Sagitta is comparable with that of Nematoda in being continuous with the ovary and in being formed from an epidermal thickening. These led him to conclude that the nearest allies of Chætognatha are the Nematoda and that the two groups diverged very widely owing to differences of habit, the former having become greatly modified for pelagic life. Based on this theory he regarded the Chætognatha as an off-shoot of a primitive coelomic stock which gave rise to the Annelids and the Nematoda.

This theory of Doncaster endeavours to reconcile the older ideas with his own observations without greatly shifting the systematic position of the group, but later Patten* discarded all the older theories and tried to establish an Arthropodan affinity of the group. This view was advanced by Grassi† who found resemblance between the cerebral ganglion of Chætognatha and Arthropoda and compared the visceral ganglion with the ganglionated chain of the latter. Patten regarded the Chætognatha as a modified descendant of the primitive Arthropod, retaining even in the adult some of the important characters of the group. According to him the body is divided into three regions: head, thorax and abdomen. The head is covered over by a hood which he compares with a bivalve mantle. The retrocerebral organ, situated in the posteromedian margin of the brain, represents the parietal eye of Nauplius. The genital cells appear very early in the segmenting egg which correspond in their early location and position with similar cells in many Arthropod embryos.

It is hardly necessary to enumerate all the points brought forward by him as they do not serve any important purpose when it can be shown that the fundamentals themselves are doubtful. His conclusions are mostly superficial and based on rather inaccurate observations which will not bear closer examination. In a previous paper‡ on the Anatomy of the Head of Sagitta, I have shown that the prehensile spines originate from seta follicles comparable to the secondary matrix of permanent setæ of Annelids, and that the retrocerebral organ very closely resembles the cerebral organ of Monostyliferous Nemerteneans in structure and function.

The retrocerebral organ is very vestigial in Spadella, but in those species in which it occurs it consists of a median opening and two appendages situated in the posterior border of the brain. From the median opening a canal passes on each side into the appendages. Each appendage is formed of large cells composed of finely granular substance surrounding the axial canal. At its anterior end an aggregation of nerve cells enter the organ from the brain and becomes wedged in between the granular cells. In this structure of the retrocerebral organ it is impossible to discover any resemblance with the parietal eye of Branchipus or Apus. In Branchipus it is a trilobed vesicle with retinal cells and dense black pigment. In the retrocerebral organ black pigment is absent and there is nothing corresponding to the retinal cells. The two appendages and the median opening suggest a remote resemblance to a trilobed organ, which seems to be the only reason for comparing it with the parietal eye.

As the development of Chætognatha is very greatly abbreviated, the evidences for deciding the affinities are to be gathered mainly from a close study of the adult anatomy and this leads more and more to strengthen the first conclusions of Huxley that the Chætognatha are related to the Annelids.

The chief objections to accepting this view have so far been that in Chætognatha, oblique septa, nephridia and blood vessels are absent. Though no blood vessels have yet been discovered,

* Patten, W., *loc. cit.*

† Grassi, B., "I Chætognati," *Fauna i. Flora des Golfes von Neapel. Monogr.*, V, 1883.

‡ John, C. C., "On the Anatomy of the Head of Sagitta," *Proc. Zool. Soc., London*, 1931.

it has been shown that 'oblique septa' are present in the trunk cavities of Spadella exactly as they occur in Polygordius.

(The term 'oblique septa' as ordinarily used in Polychæts and some Archiannelida conveys a very misleading homology. These are not true septa, but only small bands of oblique muscle fibres arranged parallel to one another with narrow spaces between each successive bands through which the so-called lateral cavities freely communicate with the median cavity; the same is true of *Spadella cephaloptera*.)

The female genital ducts in Chætognatha were first regarded as modified nephridia, but Doncaster dismissed this idea on the ground that while true nephridia are mesodermal in origin the genital ducts in Sagitta arise as epidermal thickenings. Later Stevens* showed that their real origin is as folds from the lateral mesoderm at the posterior end of the ovary.

The buccal cavity in *Spadella cephaloptera* is evertible.† In the normal condition the mouth lies in an antero-ventral position at the bottom of a shallow vestibule, but when the mouth is opened the vestibule is completely evaginated and the pharynx projects forward, recalling the similar process in Polygordius.

When we turn to palæontological history of the group we get some more convincing proofs in support of the Annelidan affinities. Chætognatha is very poorly represented in fossils. Only three specimens have been recorded and these were found in the middle cambrian formations in British Columbia. These fossil forms, *Amiskwia Sagittiformis*, Walcott.‡ are about 20 mm. long and possessed a pair of long cephalic tentacles, a single pair of lateral fins and a tail fin. The alimentary canal extended a little beyond the centre of the tail. Its occurrence in the shale with small free-swimming Crustaceans indicates that it was a free-swimming animal. The discovery of this fossil form greatly helps to explain one of the objections against the Annelidan affinity. It has been argued that the three divisions of the body, head, trunk and tail, do not correspond to metameric segments as the alimentary canal terminates in front of the tail septum. In the fossil form the alimentary canal extended to the middle of the tail and in Spadella there is a secondary space between the median septa behind the anus into which a small clump of endodermal cells projects from the hind end of the alimentary canal. This clearly shows that in the primitive forms the alimentary canal extended to the end of the tail and during later periods it was characterized by a tendency towards reduction, which finally masked the homology of the last segment.

The occurrence of prominent cephalic tentacles in *Amiskwia sagittiformis* also brings closer the similarity to Polygordius and their existence in a vestigial form in *Spadella cephaloptera* shows to some extent the degenerative process at work during the evolution of the modern representatives of the group. The Chætognatha are therefore quite possibly derived from a primitive Annelidan stock through a regressive or degenerative process coupled with the adaptation to a pelagic life. MacBride has stated that the "Fundamental type of habit common to all Annelids is a burrowing mode of existence and from that coupled with a wriggling method of locomotion during their occasional excursions we are able to deduce the main peculiarities of their adult structures." The same easy generalization extended to comprehend an active pelagic mode of life explains the probable factor in the divergence of Chætognatha from the true Annelidan type.

The absence of a trochophore stage has been very much emphasized by previous workers against the Annelidan theory. The development of an individual during its embryonic and larval stages is regarded as a recapitulation of its phylogenetic history, but apart from being a mere replica of the past it is evident that the larval stages serve a very important purpose to the future individual which develops from them. In cases where the embryo hatches out at a very early stage in development the larva is thrown upon its own resources and a long period of larval life ensues, before the adult form is assumed, during which time the larva feeds and moves about by its own activity. In other cases where the adult individual is fixed throughout life or is semi-sedentary in habits the existence of a larval stage serves an ecological function. If these are regarded as the chief functions served by the larva, one sees no reason why a larval stage should be expected during the development of Chætognatha. The majority of Chætognatha are planktonic, so that a larval stage does not serve any useful purpose. This might have, therefore, led to the abbreviation of its life-history as in the case of terrestrial Oligochæts, where the eggs develop inside a cocoon and hatch out as small worms with all the adult features. Just as the transition to a terrestrial mode of life cut short the free-swimming trochophore stage in Oligochæts, the adoption of a planktonic life in Chætognatha led to a shortening of the developmental period and the disappearance of a larval stage corresponding to the Annelidan type.

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*Stevens, N. M., "Further Studies on the Reproduction in Sagitta," *Journ. Morph. Philadelphia*, XXI, 1910.

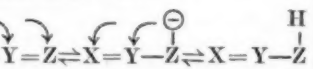
† John, C. C., "Habits, Structure and Development of *Spadella cephaloptera*" (in the press). *Quart. Journ. Micr. Sci.*

‡ Walcott, C. D., "Middle Cambrian Annelid," *Smithson. Miss. Coll.*, Vol. LVII, 1911.

Letters to the Editor.

The Electronic Theory of Triad Mobility.

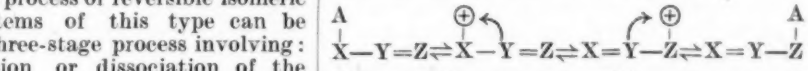
As is well known, by far the greatest number of tautomeric triad systems belong to the mobile hydrogen type, which can be represented by the general expression [H] X−Y=Z⇌X=Y−Z [H]. The moment that the electronic duplet is identified with the covalent bond, it will be seen that the reversible change involves an internal displacement of electrons, accompanied by the external transference of the so-called "mobile" hydrogen atom, which is now known to be a proton in so far as it is "mobile". The process of reversible isomeric change in systems of this type can be regarded as a three-stage process involving: (i) the ionization or dissociation of the mobile hydrogen atom, (ii) the distribution of the negative charge left on the triad residue by means of electronic displacements of the type characteristic of this type of triad mobility, and (iii) the re-association of the proton with the organic anion at the points at which the electrical charge has become localized:—



On the basis of this, it will be seen that mobile hydrogen tautomerism is merely a form, and of course the best known form, of the more general phenomenon of *cationotropy;* the picture for which will be the same as that for mobile hydrogen triad mobility with the exception that the externally transferred ion is a positively charged ion, which may or may not be a hydrogen ion. By means of this the mobility of the metallic derivatives of compounds such as the nitromethanes and β-diketones is brought into line with ordinary triad mobility in which the mobile group is hydrogen; the differences in behaviour between the mobile metal and the mobile hydrogen type being attributable to the different degree of stability of covalency union.

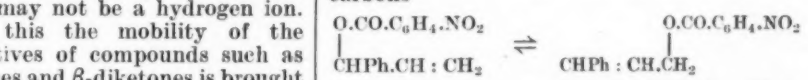
It will be seen furthermore, that on the basis of the electromeric theory just outlined, that the *mobility* of such systems, under definite sets of conditions, will depend essentially on the relative stability of the organic anions within which the *real* isomeric change takes place, and that the *equilibrium* will depend both on the stability of the isomeric anions and the strength of the covalent links by which the cation associates with them.

Cationotropy as such, represents of course only one half of the general phenomenon of triad tautomerism; the other half of which involves a mobile group which dissociates as an *anion*, leaving a cationic residue within which triad tautomeric changes analogous to those of the mobile hydrogen type take place. This half of the picture of triad mobility, which is termed *anionotropy* has only been realized within the last four years by Ingold and Burton, and can be represented in a manner similar to prototropy:—



The mobile groups in this case are, of course, those which possess stability in their anionic form, such as bromine and hydroxyl, and it has been shown by Ingold and Burton that the three main factors which facilitate anionotropic changes are: (i) the ionising power of the solvent used in the transformation, (ii) the stability of the group A in its anionic form as shown by the strength of the acid HA, and (iii) the capacity of the system to supply electrons to the ionising centre in such a way as to facilitate the dissociation of A in the form of a negative ion.

It has also been experimentally demonstrated by Burton that the group A does leave the system as an anion, and *returns to it as an anion*, by an examination of the isomerization of *p*-nitro-benzoyloxyhydrocarbons



in the presence of a soluble acetate. Thus if the *p*-nitrobenzoyloxy group migrates as a *p*-nitrobenzoate ion and in so doing, definitely separates from the cation, then acetate ions should be able to compete with it during its return. That this is the actual case, was shown by the fact that if acetate ions were allowed to compete with the *p*-nitrobenzoate ions in this way, a considerable proportion of the material undergoing isomeric change was recovered in the form of acetoxyhydrocarbons.

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A Fossil Pentalocular Fruit from Pondicherry.

SEVERAL years ago Dr. F. A. Bather, F.R.S., then Keeper of Geology at the British Museum, kindly sent me on loan, among other Indian fossils, the petrified fruit shown in the accompanying photograph. The fossil is stated to have been found near Pondicherry. The geological age is unknown, but it would probably be safe to regard it as Tertiary.

There is probably little doubt that the fruit belongs to a dicotyledonous plant, but its exact position in that extensive group has long been a puzzle to me. May I be allowed, through your columns, to request systematic botanists and foresters to come to the rescue by giving me the benefit of their knowledge of tropical angiosperm fruits?

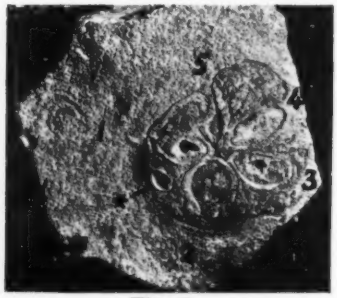

Fig. 1.

The photograph (fig. 1) shows the fruit embedded in a calcareous matrix, which was naturally weathered in such a way as to expose an almost exact transverse section of the fossil. The fruit is syncarpous and pentalocular, with a single large seed placed vertically in each fertile loculus, with its major diameter radial. One of the loculi (No. 5 in the photograph) is abortive; the cavity at * is due to an accident and has nothing to do with the structure of the fruit, as I have ascertained by means of sections. Practically nothing is preserved of the seed contents, but the rather thick and smooth, probably woody, integument shows in seed No. 2 certain features which may be of diagnostic value. In a section examined under the microscope the integument shows two layers, of which the outer is thick and consists of columner cells placed vertically to the surface (fig. 3). As clearly seen in the photograph, the seed-cavity narrows outwards into a beak-like process, at the sides of which the integument is markedly thickened. At this level the beak-like prolongation of the cavity nearly communicates with the exterior, suggesting the proximity of an outwardly directed micropyle (fig. 2). But the thickening of the integument is continued for several millimetres along the

Fig. 2.

Fig. 3.

Fig. 4. (×1¾.)

margin of the seed, and in fig. 3 (drawn from a section of the same seed cut 4 mm. below the level of the photograph), the thickening is equally pronounced, and might almost be described as a caruncle. Only a millimetre or two beyond this level all trace of the thickening has vanished. With my very limited knowledge of modern angiospermous fruits, the nearest comparison that I have been able to make is with the fruit of the sapota (Sapodilla plum, *Achras Sapota*).* With this fruit the resemblance is in some respects surprisingly close, but a very important point of difference lies in the orientation of the seed. In the sapota the micropyle faces the axis of the fruit, while in the fossil, as we have seen, it was probably directed outwards. A cross-section of the integument of a sapota seed is shown in fig. 4.

I need hardly add that I shall gratefully welcome any suggestions that may lead to an elucidation of the systematic position of the fossil.

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August 15, 1932.

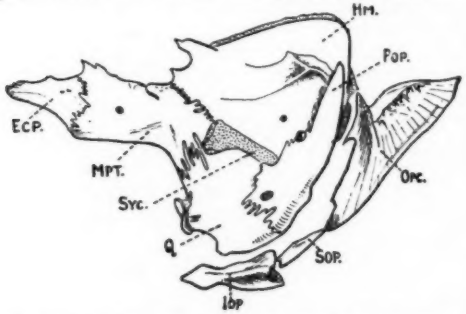
The Siluroid Skull.

THE study of the skull in the family of Siluroid fishes, from a complete investigation of the type forms in eight Indian genera, has thrown light on certain fresh points in the organization of the skull.

The myodome (eye-muscle canal) is said to be absent in Siluridæ (1 & 3). It is so in all the forms except in the primitive *Silundia gangetica* in which there is a definite, though small and vestigial myodome, roofed by the pro-otics and floored by the

* Compare figures in Engler & Prantl, *Nat. Pflanzenfam*, **4**, p. 138 (1897).

parasphenoid and the basi-occipital. It is regarded that there is only one pterygoid bone (metapterygoid) in the skull of Siluroid fishes (2 & 3). But besides the metapterygoid there is a clear ectopterygoid present



The pterygoquadrate bar and the opercular apparatus of Plotosus canius.

Ecp.—Ectopterygoid; *Mpt.*—Metapterygoid; *Syc.*—Symplectic cartilage; *Q.*—Quadrate; *Iop.*—Interoperculum; *Sop.*—Suboperculum; *Opc.*—Operculum; *Pop.*—Preoperculum; *Hm.*—Hyomandibular.

in all the forms. In *Rita buchanani* the ectopterygoid is small and has lost its firm connection with the pterygoquadrate bar. It is attached firmly with the orbitosphenoid. Only a close observation reveals its presence in Rita. It is toothed in Silundia. Silundia possesses a minute entopterygoid also. In this family the suboperculum is stated to be absent (4) or that the first branchiostegal ray represents this bone (2 & 5). While it is absent in the six forms there is a small but definite suboperculum in Plotosus canius and Osteogeneosus militaris. Besides, Kindred has pointed out the presence of a small suboperculum in Amiurus catus. This clearly shows that while it is generally absent, it is vestigial in certain forms and that the first branchiostegal ray cannot be homologized with the suboperculum. A small supratemporal which is firmly articulated with the cranium is present in all the forms. The cranium is platybasic, the cranial cavity extending between the orbits to the ethmoid region. In the advanced forms Arius and Osteogeneosus the cranial cavity stops short about the middle of the orbitosphenoid, only the olfactory nerves piercing through the anterior portion of the orbitosphenoid and ectethmoids.

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Department of Zoology,
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August 17, 1932.

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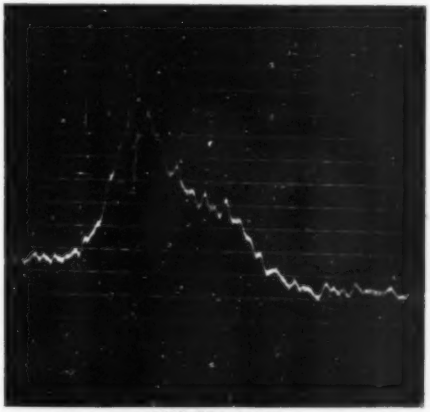
The Structure of Hα Absorption Markings on the Sun.

EXAMINATION of a large number of absorption markings in spectro-heliograms of the sun taken in Hα light has revealed that the intensity of absorption is not uniform across the width of a marking. It is found that in every well-defined marking there is a line of maximum absorption running along its length and that the position of this line depends on the lie of the marking on the solar disc. For example, when a longitudinal marking lies along or near the central meridian, the line of maximum absorption runs along the middle and when the marking is farther and farther away from the central meridian, this line shifts towards the limb side and finally, when near the limb, the marking is actually bordered by this line of maximum, so that the absorption falls off abruptly and the general level of intensity of the solar surface is reached. The same phenomena are observed in other cases also. When a marking is radial on the disc, the line of maximum absorption is symmetrically situated at the centre and shifts from



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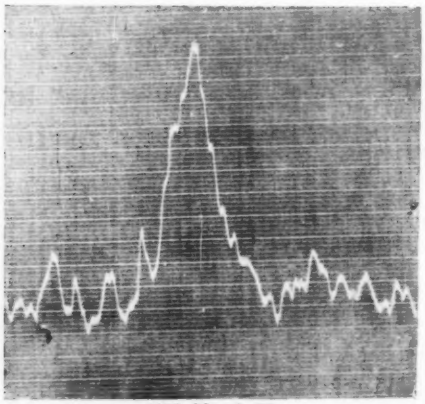
Marking at Long. 22° W.



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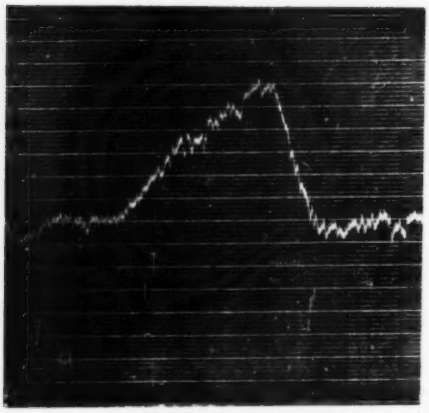
Marking at Long. 5° E.



1927 March 20
Marking at Long. 32° E.

this position towards the limb, when the marking deviates from the radial position.

The accompanying micro-photometer curves show the variation of absorption across the breadth of a longitudinal marking as it transited the sun's disc from the 19th to the 26th March 1927. Only three curves are given here showing the absorption when the marking was (1) on the eastern hemisphere, (2) very near the central meridian, and (3) on the western hemisphere. The symmetrical nature of the middle curve and the shift of the peak in opposite directions, *i.e.*, towards the limb side, where the curve becomes steep, are quite evident.

It is hoped that that these observational facts will afford an important clue to the structure of the absorption markings. The results can be explained if it is assumed that the cross-section of the mass of hydrogen gas involved is roughly triangular in shape with its base up. The subject will be dealt with more fully elsewhere.

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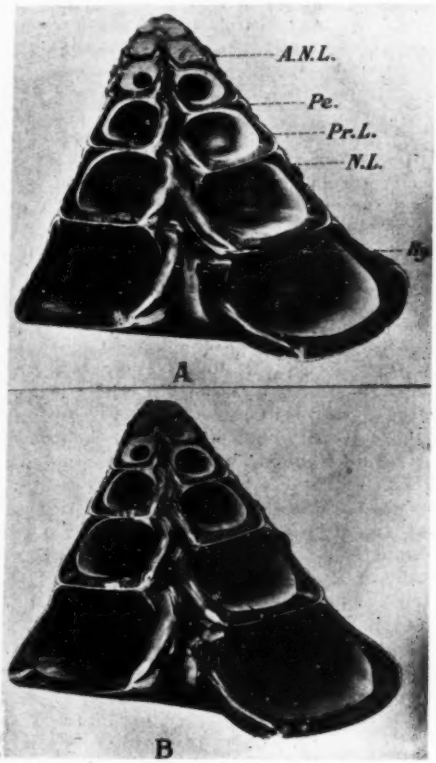
Kodaikanal Observatory.
August 23, 1932.

Correlation of Sex and Shell Structure in a Mollusc—*Trochus niloticus* Linn.

MOLLUSCAN shell has attracted the attention of both laymen and scientists alike for a long time. From the scientific aspect a good



Longitudinal Sections of the Trochus Shell.
A. Male of 9.87 cms. B. Female of 9.76 cms. in diameter showing the oval and the angular shape of the cavities respectively.
A.N.L.—"Amorphous" Nacreous Layer; *Hy.*—Hypostracum; *N.L.*—Nacreous Layer; *Pe.*—Periostracum; *Pr. L.*—Prismatic Layer.

deal of literature exists on the shape, size ornamentation and structure of the shell; there is a certain number that deals with the relation of the shell to sex. This link, so far, is confined to the size of shell as an indication of the sex. Here, I propose to show that in a mollusc, *Trochus niloticus* Linn. (Top or Pagoda shell) from the Andamans, the sexes can be determined by longitudinal sections of the shell—passing through the extreme end of the suture of the outer lip to the body whorl and the columella. Sections of various individuals ranging from 5–12 cms. in maximum diameter were cut and polished by the usual method.

On examination, two facts emerge. Firstly, the various layers of the shell in both sexes seem to be constant, *i.e.*, it contains the usual three layers of the molluscan shell namely the periostracum (Pe.), the prismatic* (Pr. L.) and the nacreous layer (N.L.). The fourth layer, the hypostracum (Hy.) is found on the columella for muscle attachment. An "amorphous" form of the nacreous layer (A.N.L.) is found to fill in the cavities in the apical region and also line the area where the gonad is lodged. These various layers are labelled in Fig. A. The fact that the "amorphous" nacreous layer completely obliterates the apical cavities and grades down in thickness towards the body whorl, indicates that this is deposited as the animal grows. It is quite probable that this "amorphous" deposit—composed of hard material—is analogous to that found in the shells of *Ostrea edulis*† and that it is deposited to fill in rapidly the space created by the anterior migration of the gonadial twist during growth.

Secondly, the shells of 7 cms. or over in diameter form two definite categories, depending on the shape of the cavities. In the male the shape inclines to be oval, *i.e.*, the angles are obtuse as in Fig. A. This is best observed in the cavities—Nos. 2 and 3 counting from the base—on the left side of the columella. In the female, it is inclined to be angular, *i.e.*, the angles are not so obtuse [see Fig. B]. Again the cavities in the same position illustrate this point clearly. It is therefore evident, that the sex of a mature individual can be ascertained from longitudinal sections. This conclusion was reached after examining sections of about a hundred individuals of known and unknown sex. Further I found that *Trochus niloticus* reached maturity in two years when it attains a size of 6-7 cms. in diameter. Therefore, as would be expected, the shells of about 7 cms. or below in diameter do not show markedly this above difference in the shape of the cavities.

C. AMIRTHALINGAM.

Port Blair and Calcutta.

* The terms used here are those generally accepted by English-speaking authors; those used in a Memoir on *Pila* (*The Indian Zoological Memoirs*) differ from this terminology.

† J. H. Orton & C. Amirthalingam, Notes on Shell Deposition in Oysters, *Jour. Mar. Biol. Assoc.*, **14**, 935, 1926–27.

Mineral Metabolism and Hyperplastic Goitre.

BAUMANN, Kurland and Metzer have recently reported an association between calcium retention and hyperplastic goitre caused in rabbits by exclusive feeding on cabbage. S. Ranganathan, working in these laboratories, has failed to find any such association when the goitre so produced is of a size not exceeding 170 mg. per kilogramme of body-weight. But when it is of larger size this association has been observed, though so far only in one animal whose goitre weighed 293 mg. per kilogramme of body-weight. It has been observed, further, that the addition of lime to the cabbage diet increased the goitrogenic potency of the latter during the hot, dry months of the year in this locality—a time when the potency is at its lowest ebb. The addition of calcium made no appreciable difference in the urinary excretion of calcium, magnesium and phosphorus; the serum-calcium values were also within normal limits. It has been noted that while the thyroid enlargement caused by insanitary condition in albino rat fed on a diet composed of cereal grains and fresh cabbage is associated with a signifcant increase in size of the adrenal glands and spleen and a significant diminution in size of the testes and thymus—the size of other organs remaining unchanged (the pituitary gland was not examined)—no such change in size of these organs occurs in association with the hyperplastic goitres produced in rabbits by an exclusive diet of cabbage.

R. MCCARRISON.

Nutritional Research Laboratories,
Coonoor, *August* 24, 1932.

A New Disposal System for Municipal Wastes.

IT is universally acknowledged that much yet remains to be done to secure an adequate standard of sanitation to maintain proper health for both urban and rural populations in India. Want of funds has seriously hindered a practical solution of the problem.

A number of fermentative processes have been devised for the disposal of night-soil and town refuse with varying degrees of sanitary and economic success. Recently, great advances have been made by Dr. Gilbert Fowler and his collaborators.* The problem has been attacked lately from a different standpoint at Indore and a very simple and profitable system for sanitary disposal has now been developed on similar lines to the Indore process of composting agricultural wastes.†

The features distinguishing it from other systems known to the writers are that widely varying proportions of refuse to night-soil can directly be dealt with, and that no activation, chemicals, or antiseptics are necessary. The process is being successfully worked at the disposal grounds of both the City and Residency areas at Indore. It is free from nuisance, cheap and simple enough to be handled efficiently by the sweeper-class without supervision. It works equally well under dry and hot, or wet conditions, having withstood a continuous rainfall of 21 inches within 20 days.

The technique is equally adaptable to the needs of large and small communities, with or without a piped sewage system. The authorities at the city depot now expect to earn a handsome revenue from the disposal of waste. A larger quantity of organic manure superior to that obtained at present is manufactured within 3 to 6 weeks. Cultivators have eagerly purchased it, showing they appreciate its agricultural value.

A universally useful organic manure must approximate in composition to natural soil-organic matter, having its nitrogen in stable, yet easily available form. Mere high analysis has only a partial value in the estimation of efficiency in the field. This point has been kept well in view during the elaboration of the process.

F. K. JACKSON.
Y. D. WAD.

Institute of Plant Industry,
Indore (C.I.)
August 30, 1932.

WE have been engaged for the past few years on problems connected with the utilization of town refuse and waste vegetation and our experience has shown that although sullage or sewage (raw or treated) can be sprayed, as such, on the refuse heap, night-soil will first have to be partially liquefied before it can be evenly mixed with the refuse. Under normal conditions the final product has a nitrogen content of about 1 per cent irrespective of the amount of sewage or night-soil added, the extra quantity being lost in the gaseous form. Indications have, however, been obtained to show that in presence of (1) activated sludge as the starter there is evidence of fixation of atmospheric nitrogen, (2) minute quantities of certain inorganic salts like those of copper, zinc or titanium there is not only a marked change in the composition of the active microflora, but also greater conservation of carbon and nitrogen in the heap than would otherwise be the case.

V. SUBRAHMANYAN.
J. JAGANNATHA RAO.

Indian Institute of Science,
Department of Biochemistry,
Bangalore.

A New Enzyme Preparation.

THE inadequacy of the form in which enzyme preparations are at present available on the market for general laboratory use, led us to the preparation of enzyme-papers which promise to offer a very convenient mode of handling enzymes quantitatively with rapidity and ease. The preparation consists either in dipping filter-papers in enzyme solutions or spraying the solution on to the filter-paper and desiccating the paper in vacuo over calcium chloride. The papers are standardized in terms of enzyme activity and expressed as units per sq. cm. The enzyme content can, therefore, be calculated directly on the area of the paper used. Filter paper preparations of diastase and emulsin have yielded successful results and have kept their activity for over a year. In

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* "Recent Experiments on the Preparation of Organic Matter," *Agric. Jour. of India*, **25**, 369, 1930, and subsequent press announcements.

† *Waste Products of Agriculture*, Howard and Wad, Oxford University Press, 1931.

the case of hygroscopic enzyme preparation like pancreatin or pepsin, however, it is obviously not possible to extend this technique.

For commercializing the preparation, the paper can take the form of strips (10×3 cms.) divided into squares by thin lines. Among the advantages claimed for this preparation is the ready availability of a standard preparation, the employment of which for quantitative work is rendered extremely easy since one has only to cut out a measured area of the paper and directly put it into the test substrate.

M. SREENIVASAN.
M. SREENIVASAYA.

Indian Institute of Science,
Department of Biochemistry,
Bangalore, *August* 23, 1932.

Attempts to produce Uric Acid Calculi in Albino Rats.

IT is known that rats have a high uricolytic index, but whether there is any limiting value to the uric acid excreted in their urine is not definitely known.

An attempt was accordingly made to ascertain whether the ingestion of pure uric acid, in large amount, would appreciably increase the uric acid content of the urine. It was found that it did not do so, even when it was ingested in amounts as large as 200 mg. per rat per day. The usual explanation given of the relatively low excretion of uric acid in the urine of rats is that it is converted into allantoin by uricase. It was expected, therefore, that the high ingestion of uric acid would lead to a relatively high excretion of allantoin in the urine. No such increase in its allantoin-content was, however, observed. To faciliitate a better assimilation of the ingested uric acid, sodium carbonate, in amouts necessary to form sodium urate, was administered with it. Even then, there was no appreciable increase in the uric acid, allantoin or total nitrogen-content of the urine. Subcutaneous and intravenous injections of an isotonic solution of uric acid did increase the uric acid, allantoin and total nitrogen content of the urine, but the increase in uric acid was not commensurate with the amount of uric acid ingested. The subcutaneous injection of as much as 288 mg. of uric acid raised the uric acid content of the urine by barely 6 mg. The results, so far obtained, appear to indicate that there is a definite, and relatively low, limiting value to the excretion of uric acid by the albino rat above which uric acid present in the blood stream is converted into some other product, and excreted. What this product is, is not definitely known. Phenyl-cinchonic acid is known to mobilize the uric acid in the tissues of man and to get rid of it in the urine. It was observed that when this substance was administered to rats along with uric acid subcutaneously, the excretion of uric acid was increased three-fold; this increase being associated with a greatly increased excretion of urine so that the percentage urinary excretion of uric acid remained much the same as when phenyl-cinchonic acid was not administered: a result similar to that reached by Krafka in Dalmatian dogs, whose uricolytic index is low. Prolonged feeding on glandular organs rich in purine bodies, such as spleen or liver, did not lead to any great increase in the uric acid content of the urine. These results would appear to indicate that the experimental production of uric acid calculi in albino rats is not possible.

R. MCCARRISON.
S. RANGANATHAN.

Nutritional Research Laboratories,
Coonoor, *August* 24, 1932.

On the Nuclear Spin Moment of the Tl Atom.

IN a recent note in *Nature** it was reported that the fine structures of the important arc lines of Tl could be explained if each of the two isotopes was assigned a nuclear spin moment of $\frac{1}{2}$ $(h/2\pi)$. The structure of the line 3776 $(6\,^2P_{\frac{1}{2}}—7\,^2S_{\frac{1}{2}})$ was studied in detail and was found to show more components than Schüler and Keyston† observed. While the value of $i=\frac{1}{2}$ was sufficient to explain the H.F.S. observed in 5351 and other arc lines, the complex structure of 3776 remained to be accounted for. Using a low current vacuum arc of an amalgam of Hg and Tl as source‡ and Quartz Lummer plate (200×30×8 mm.) and fused silica etalons, we find the line to be a group of 6 components as shown below:—

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* *Nature*, October 17, 1931.

† *Zeit. fur. Physik Band*, **70**, pp. 4–10.

‡ This lamp was kindly made for the author by Prof. Venkatesachar.

3776. $6\,^2P_{\frac{1}{2}}$—$7\,^2S_{\frac{1}{2}}$	$d\lambda$	$d\nu$
	+0.064	—0.448
	+0.057	—0.399
	+0.010	—0.070
	0.000	0.000
	—0.530	+0.371
	—0.093	+0.651
	—0.101	+0.707

On account of the closeness of the satellites, the measurements made on the Lummer pattern have not been sufficiently accurate

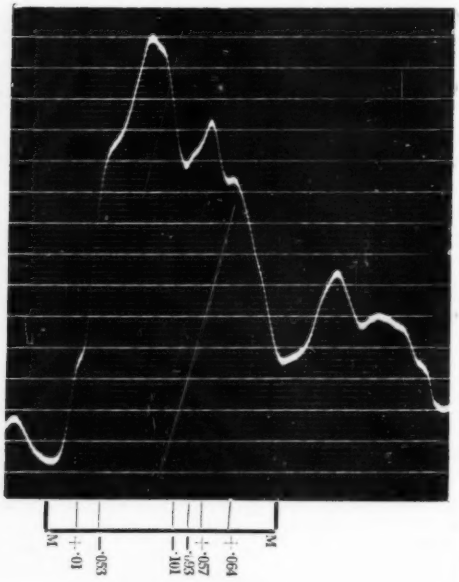

Fig. 1.

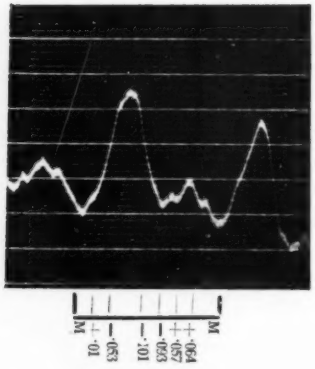

Fig. 2.

to fix the wavelength interval without ambiguity. The wavelength intervals of +0.057 and —0.101 have however been accurately determined from etalon photographs. The values assumed here for the other setellites are the weighted averages of several measures made on the Lummer patterns.

From a consideration of the distribution of the satellites indicated in the above table it is found that the complexity of structure of this line could be quantitatively explained if we supposed that $^2P_{\frac{1}{2}}$ term like the $^2P_{3/2}$ term shows an isotope displacement of about 0.050. Microphotometric traces of the Lummer pattern for 3776 for two different current values are shown in the accompanying figures 1 and 2. The diagram of structure is indicated at the bottom in each case. The observed component at —0.053 does not find a place in this scheme and it has also been observed by Wali Mohammad.* It is interesting to note from these curves that slight variations in the excitation bring about marked changes in the relative intensities of the components, a fact that has been recently noticed by Schüler and Keyston and Subbaraya and Iyengar in the case of mercury.

These observations together with those previously reported by one of the authors confirm the isotope displacement effect observed in the H. F. S. of Tl 1 lines.

A. L. NARAYAN.
A. S. RAO.

Kodaikanal Observatory,
August 20, 1932.

On the Migration of Mineral Salts from the Plant into the Soil.

TEXT-BOOKS on Botany, Plant Physiology and Agricultural Chemistry are silent on the ultimate fate of mineral matter absorbed by a plant from the soil. It appears to have been tacitly understood that the mineral constituents absorbed by a plant from the soil remain in the plant. Recent work on plant nutrition shows that there is a backward move of salts from the plant into the soil and that a portion of the mineral matter taken in flows back into the soil at least when the active life functions are over.

Wilfarth, Romer and Wimmer,† from their studies on assimilation of the elements

* *Phil. Mag.*, Vol. V, May 1928, pp. 1111–1114.
† *Landw. Versuchs-stat.*, **63**, 1, 1905.

of nutrition by barley, wheat, peas, mustard and potato at different periods of their growth in the field, were the first to suggest a back flow of minerals from the plant into the soil. Later studies by different works on similar lines supported the findings of Wilfarth and his associates. Le Clerc and Breazeale* and André† were of the view that the loss of mineral matter from the plant occurred as the result of washing from the leaves rather than from the root.

Independent evidence, which will soon be published, in support of the mineral migration hypothesis is forthcoming from the soil solution studies in the laboratories of this Institute. The concentration of the soil extract from the cropped soil is lower than that of the uncropped one during vigorous growth period of cotton crop. After this period the difference becomes gradually less and soon the concentration of the soil extract from the cropped soil becomes higher and continues to be so till the end. The migration of nutrient salts from the plant into the soil is thus evident. The plant like any other organism draws up its food requirements during the growing period, then ceases absorption and maintains itself without further appreciable indent on the soil. When the assimilation and elaboration of the absorbed material is over and the final ripening stage is reached, the surplus mineral constituents are sent back into the soil.

B. VISWA NATH.
M. SURYANARAYANA.
Agricultural Research Institute,
Coimbatore,
September 3, 1932.

* *U.S. Dept. Agric. Year Book*, 389-402, 1908.
† *Compt. rend.*, **151**, 1378, 1910.

Research Notes.

The Structure of Atomic Nuclei.

IN *Zeitschrift für Physik* (**77**, 1, 1932), W. Heisenberg considers the possibility of deducing the properties of the nuclei of different elements, particularly those of heavy elements in relation to radioactive transformations from the hypothesis that all nuclei are built up of protons and neutrons alone without any free electrons. He assumes the neutron to be a single entity which is capable of disintegrating into a proton and an electron under certain circumstances, rather than considering it as a structure made up of a proton and an electron. He finds it necessary to assume that neutrons follow the Fermi statistics and possess a spin of $\frac{1}{2}h/2\pi$ so as to explain the behaviour of the nitrogen nucleus. On the analogy of the H_2^+-ion and H_2-molecule, the forces between proton and proton, proton and neutron, and neutron and neutron are assumed to consist in an electrostatic repulsion between the protons, an attraction between proton and neutron due to an oscillatory exchange of the negative charge between them, and an attraction between two neutrons, respectively. Relativity effects are supposed to be negligible. When the sum of the kinetic energy of the particles and the energy due to the exchange of negative charge between proton and neutron alone is considered, it is found to be a minimum when the nucleus has as many protons as neutrons; thus the fact that the atomic weight is nearly twice the atomic number is explained. When the number of protons increases, the energy due to their repulsion can no longer be neglected and the ratio n_1/n_2 of the number of neutrons (n_1) to that of protons (n_2) becomes larger and larger than one as the atomic weight increases. It is also found that a nucleus containing neutrons alone will be most stable when their number is two. The Helium nucleus containing two protons and two neutrons should therefore be expected to be very stable and its total spin should be zero. Experiment fully confirms these conclusions.

The examination of the mutual forces between two nuclei leads to the conclusion that at great distances they repel each other but at small distances they become firmly bound by a kind of Van der Waals' attraction and also the attraction of the neutrons.

Assuming that the force due to the exchange of negative charge is greater than the attraction of the neutrons, it follows that a nucleus made up of neutrons only will decrease in energy content when a neutron is replaced by a proton. Hence such a nucleus will go on suffering β-transformations till the energy that becomes available by the addition of a proton exactly equals the energy required to remove the neutron. When the ratio n_1/n_2 falls below a critical value, particularly in the case of

heavy nuclei, the Coulomb repulsion between the protons outweighs the attraction of the neutrons. The nucleus then suffers an α-transformation. We expect an α-particle to be given out rather than a proton, because the protons and neutrons would be present in the nucleus in the form of α-particles on account of the extraordinary stability of the combination of two protons and two neutrons. Thus if we consider that at the head of a disintegration series there is a nucleus with an even number of protons and that it is stable with respect to a β-transformation, we should expect it to give out α-rays until n_1/n_2 exceeds the critical value. Then a β-transformation takes place leaving an odd number of protons. But if another proton takes the place of a neutron, an α-particle would be capable of being formed inside the nucleus and this should result in a diminution of the energy of the system. Hence we should expect two successive β-transformations when the initial atomic number is even. This prediction is confirmed by all three radio-active families. Thus in the Thorium series two consecutive β-transformations occur twice and in both cases n_1/n_2 has the values 1.585 and 1.55 nearly. The same thing occurs in the Radium series when n_1/n_2=1.595 and 1.57. In the Actinium series which begins with an odd atomic number there is first a single β-transformation when n_1/n_2=1 596 and then two consecutive β-transformations occur when n_1/n_2=1.62 and 1.59. However, two consecutive β-transformations occur in the Radium series for the third time and in this case n_1/n_2=1.56 and 1.53. This shows that besides the value of n_1/n_2 and the stability of the Helium nucleus other factors should also play a part in the determination of the stability of nuclei.

Disintegration of Rocks.

[By Mohammed A. R. Khan, *Begumpet, Deccan.*]

THE formation of laterite from the decay of basalt is well known; but it does not appear that much attention has been paid to the resulting of loose sandstone (or "*moram*" as it is locally called), from the decay of granites and trap-rocks, *mainly* by the action of roots of several varieties of thorny plants. Microscopic and specific gravity examinations of several rocks have shown that where the rock has been acted upon by tiny roots and plants, the felspar and hornblende have been observed to have undergone complete or partial decomposition, portions of the same rock not subjected to this action retaining their normal compactness and composition. The specific gravity of the disintegrated rock powder is always less than that of the unaltered rock powder. The "*moram*" soil of the Deccan, which is formed from the decay of granite or trap rocks, is probably mainly due to the action of plant roots. Among the plants which take a prominent part in this kind of action may be mentioned *carissa carandus*. There are several other plants also which occur more frequently and act more formidably which have not yet been identified.

Breeding for Disease Resistance at Dharwar.

[By G. L. Kottur, *Dharwar.*]

FUSARIUM wilt is a serious disease for Kumpta cotton in the whole of the Bombay Karnatak. On the Experimental Station at Dharwar it first made its appearance with Broach cotton in the year 1909 and in about twelve years time rendered the whole area unprofitable for cotton growing. To remedy the situation, selection for wilt resistance was taken up and Kumpta cotton was grown in plots known to be highly infected by the disease. Although the crop was practically wiped of, few individuals did survive to produce cotton. The seed of such plants was individually collected and tested in the same way. Following the selection we have now a large number of wilt-resistant cottons, one of which is Dharwar 2, a strain of Kumpta. This resists wilt to the extent of 90–98 per cent on highly infected plots where Kumpta suffers by 60 per cent or more. In other economic characters, specially the staple, it is, however, wanting. For this purpose the cross was made between Dharwar 2 and another pure strain of Kumpta, *viz.*, Dharwar 1. This cross has yielded a type that possesses the desirable characters of both the parents and its seed is being distributed for cultivation under the name of Jayawant. Last year it was cultivated on an area of more than a lakh acres in Dharwar, Belgaum and Bijapur districts and it resisted wilt remarkably everywhere.

X-Ray Diffraction Studies of Calculi.

[S. Ranganathan, *Pasteur Institute, Coonoor.*]

X-RAY diffraction studies were made of vesical calculi (human and cattle), of gall-stones from human beings, and of pure uric acid and cholesterol. It was found that in all the varieties of calculi examined, the substance or substances constituting them were deposited in the crystalline state, though a little variation in the order of magnitude of the crystals was observed. Uric acid in human calculi and calcium carbonate in cattle calculi were definitely shown to exist in the crystalline state. Gall-stones presented several interesting phenomena, chief of which were the occurrence of intensity maxima arcs due to the orientation of the crystals in certain preferential directions, and the contraction of the rings due to the extremely fine state of division of the cholesterol crystals. An explanation has been offered, in the light of the X-Ray analysis, for the existence of the pigmented and the non-pigmented varieties of gall-stones.

The Effect of Temperature on the Leg Posture and Speed of Creeping in the Ant Lasius.

IN a paper in the *Biological Bulletin* (62, No. 3, 1932), T. Cunliffe Barnes and Henry I. Kohn describe an attempt to investigate the influence of temperature upon the locomotion of ants *Lasius niger* and *Lasius umbratus*.

The ants were allowed to crawl over smoked kymograph paper, and the trails made by the metathoracic legs were photographed, the experiments being conducted under different temperatures. It was discovered that the leg-spread factor increased with the rise of temperature.

To calculate the speed, the ants were allowed to crawl in a glass tube, both the ends being closed with moist cotton. Using certain equations, graphs are drawn and it is also proved that the speed of progression in *L. niger* shows a critical temperature at 20° and yields two values for μ; 10,700 between 16°–20° and 22,900 between 20°–25°.

On Plasmodicid Action of Atebrin.

EXPERIMENTS conducted in Dr. Mello's laboratory and the Hospital in Nova Goa in collaboration with Dr. L. J. Eras de Sa and Antonio d'Azevedo have shown: that Atebrin (known also as *Erion*), a synthetic drug whose composition will be known this year, has a destructive effect in all forms of *Pl. vivax* and *malariæ* and on Schizonts of *Pl. falciparum*. The gamets of this last species remain unaltered. Clinically, the fever comes to normal in 24 hours to 4 days. Acute splenomegalies respond also quickly to this treatment. Atebrin seems, if not superior, at least equal to quinine in checking malaria, and its combination with Plasmoquine will be a very useful means for the sanitation of malarious countries (full report not yet published).

Circulation of Blood in the Air-Breathing Chambers of Ophiocephalus Punctatus.

IN the last number of the *Journal of the Linnean Society of London* (Vol. 38, No. 257, 1932) S. H. Lele makes a brief reference to the habits of the Ophiocephalid fishes and gives an account of the form, position and associated structures of the air-breathing chambers of *Ophiocephalus punctatus* Bloch. Attention is directed to the highly vascular nature of the relatively thin and so-called "practically non-vascular" membrane lining the roof of the air-chambers. As regards circulation it is indicated that the first and second bronchial arteries after giving small branches to the gills are continued as large vessels to supply blood to the air-chambers. The capillaries of the air-chambers drain into the tributaries of the anterior jugular vein. Special attention is directed to the fact that the oxygenated blood gets mixed up with the venous blood. The third and fourth afferent arteries after giving small branches to the gill-filaments are continued as large vessels to join the suprabranchial of their side. In this way the blood passes through them directly to the arterial system without oxygenation in the branchial filaments of the gills. From these observations Mr. Lele suggests that this defective circulation may have induced the evolution of the four-chambered heart of the higher vertebrates from the two chambered heart of fishes.

Carpel Dehiscence in Firmiana Simplex.

[Tsu-Kiang Yen, *Bot. Gaz.*, 93, No. 2, 1932.]

THE follicle of Firmiana simplex (L) W. P. Wight, is of interest in that in early stages of its development the carpel edges are distinct and separate, later they are

firmly united and still later they are again widely separated. The material was collected at the National Central University, Nanking, China, and was investigated at the Hull Botanical Laboratory, University of Chicago. The coalescence of the two rims of a single carpel is by means of close approximation, cell-division and cell-enlargement. Development of additional sutural tissue is brought about by the activity of the cells at either margins of the carpel, which meet and then divide tangentially to the suture. The two placental bundles are partly responsible for the fusion of the carpel margins. Coalescence of the stylar region takes place before pollination and later entire style withers and is broken off. Carpels open by mechanical breaking, thus rupturing the individual cells. The coalescence of carpels is ephemeral and exists only during the period of pollination as if the five distinct carpels are joined throughout their common stylar region. This may indicate also that the pistil is an intermediate stage between the apocarpous and the syncarpous conditions.

On Some Nematode Parasites of Goats and Sheep at Muktesar.

By G. D. Bhalerao,

Helminthologist, Imperial Institute of Veterinary Research, Muktesar.

THE goats and sheep that are used for experimental work at Muktesar appear to be very rich in their parasitic fauna which presents very interesting features. An investigation into these has been in progress for over a year and a detailed account of the different interesting parasites and the part they play in the economy of their hosts, is in the process of publication. The parasites were collected from four kinds of animals: Hill and Tibetan goats (*Capra sibirica*), hill sheep (*Ovis nahura*) and Tibetan sheep (*Ovis hodgsoni*). All these animals were used for maintaining the Rinderpest virus at this Institute.

The entire collection consists of several worms but it is not intended to refer here to them all. The remarks will be limited to such parasites only as are altogether new to science or to those that have not been recorded from India upto the present time. In one case are given some interesting variations in the structure of a very common parasite which, in spite of their frequent occurrence, are altogether unknown.

A nematode belonging to a new genus of the family Metastrongylidæ (and a new species), *Varestrongylus pneumonicus*, gen. et sp. nov. was discovered in the bronchi of the goats and sheep. This parasite is very interesting from the zoological standpoint in that the females possess a valve covering the vulva and the anus is situated at the posterior end, features hitherto unknown among the members of the family Metastrongylidæ. The males also possess many interesting features particularly in regard to the genital bursa, the spicules and some chitinous structures connected with them.

Besides the morphological interest of the parasites they have a very great economic value, since they were found in all animals which had died of broncho-pneumonia. The worms being present in the bronchi bring about the asphixiation of the animals. In the post-mortem examination, the bronchi are found filled with a frothy secretion. They also possess a very great capacity for laying eggs which fill up almost completley the whole of the lung tissue and bring about its congestion.

Experiments to evolve a successful treatment of this abominable scourge of these animals are in progress. Some of the drugs recommended strongly by some American and German authorities met with no success in this country.

A new species of worm, *Dictyocaulus uniqualis*, was found in the bronchi of a Tibetan sheep. The males of this species have a structure somewhat different from *D. filaria*, particularly in regard to the bursal rays. The animal from which this parasite was recovered had also died of broncho-pneumonia.

Two parasites of the family strongylidæ, *œsophagostomum venulosum* and *O. asperum* from the cæcum of hill goats have been obtained for the first time in India.

A new parasite, *Ostertagia orientalis*, has been discovered from the cæcum and abomasum of hill goats. This species appears to be somewhat less common than the species *O. circumcincta* which is found in almost 60 per cent of the goats at Muktesar. It is rather surprising to find that there exists no previous record of the occurrence of the latter species in spite of its very large incidence. This may, presumably, be due to the fact that these worms produce no pathological symptoms and for this reason their presence may have so far remained unnoticed. Only one male specimen of the species *O. occidentalis* was obtained from the cæcum of hill goats.

The species *Hæmonchus contortus* found so commonly among the goats and occasionally in the abomasum of cattle presents very interesting variations in regard to the structure or structures developed in the vicinity of the vulva. In all the text-books on helminthology this species is described to possess a well-developed linguiform process or flap overhanging the vulva, but the specimens at Muktesar exhibit various gradations of the development of this flap and in some cases it may be bi-lobed resembling the head of a bird. Occasionally, one or more cuticular bosses may be developed in the neighbourhood of the vulva and specimens are not wanting in which are developed neither the bosses nor the flap.

The Industrial Outlook.

Ceramics.

B. K. Ramprasad.

A FACTORY for the manufacture of porcelain insulators for electrical purposes and ordinary crockery on a small scale has been started by the Government of Mysore, in Bangalore. It is learnt that the first batch of insulators have been successfully fired and have passed the electrical and mechanical tests satisfactorily. The Hydro-Electric Department of the Mysore Government and the Department of Industries and Commerce have carefully surveyed the requirements of the local electrical supply schemes and others in Southern India and it is expected that the Factory will be able to meet the demands satisfactorily so far as insulators up to 13,000 volts are concerned. This is just the beginning, and much development and research work is to be done hereafter to utilize the local raw materials to the best advantage and also modify the processes accordingly. At present, an intermittent coal fired furnace is being used for the different stages in firing, but the utilization of electric heat by means of a suitable kiln will have to be adopted, as sufficient power at reasonable rates is available in Bangalore, and coal has to be imported either from Bengal or abroad.

Intensive research from the point of view of the physics and chemistry of Ceramics is to be carried out with the available raw materials in order to meet the rigorous demands of electrical porcelain: high voltage research on the porcelain products is also necessary to keep up the quality. It is lucky that the Factory is located near the Indian Institute of Science and it is hoped that the various problems of Ceramics in general and of the Porcelain Factory in particular will be taken up for investigation in these laboratories.

* * *

USE of the new protective material known as "Thiokol" for electrical purposes has been taken up by the General Cable Corporation under a licensing agreement with Thiokol Corporation. Extensive tests over a two-year period have demonstrated that a jacket of proper Thiokol compound over rubber is superior to the rubber itself in resistance to chemical action, fatigue, sunlight, oil, vibration and corona. It also has advantages as cable sheathing. Development work is already in progress to complete the adaptation of the new material to power cables, overhead conductors and secondary net-work conductors. It will also be employed for wire pertaining to general industrial uses where rubber is subjected to the deleterious influence of oil, acid, weather or light. The field at this time is limited to 600 volts. (*Electrical World*, July 16, 1932.)

* * *

The latest of the contributions of electrically deposited metals to the advancement of industry is the use of chromium plated steel. Mill rolls, roller leveller rolls and cold finishing rolls are notable uses. In the case of the former it is possible to substitute ordinary forged steel (0.70 to 0.80% carbon) for tool steel and it is said that by having a well grounded finish on the roll before chrome plating, a much higher finish can be offered than with a tool steel roll. Because of the extreme hardness of chromium these plated leveller rolls remain in service over a long period of time often outlasting a tool steel roll for 4 to 6 regrinding periods. When the plated leveller rolls finally indicate some wearing through of the chromium plate, provided the underlying steel has not been marred, the plating can be stripped and again chromium plated without regrinding. The cost of such plating is said to be relatively inexpensive considering the initial cost of the rolls. (*Electrical World*, July 23, 1932.)

* * *

An X-ray machine that can take snapshots and that will be able to photograph moving internal organs of the body has been developed and is now being tested by the New York Hospital—Cornell Medical Centre. It takes pictures about 20 times faster than the ordinary radiograph and will be able, because of the increased amount of light that can be used, to photograph clearly such soft tissues as incipient ulcers, ruptures of the muscles and cancerous growths. Research workers and technicians of the General Electrical Company worked in collaboration with Dr. John R. Carty, Radiologist of the New York Hospital and Associate Professor of Radiology at Cornell University Medical College, to perfect it. (*Electrical World*, July 23, 1932.)

A New Process for Wood-Preservation.

[R. Falk and S. Kamesam, *Ind. Pat.*, 18580 of 1932.]

THE invention is based on the observation that when mixtures containing arsenic compounds and chromium salts in aqueous solutions are used for impregnating wood, neither of the two components get washed out within a certain range (As_2O_5 : $K_2Cr_2O_7$ = 1:1.25 to 1:1.75) while at others either the arsenic or the chromium salt passes out quite readily. A preservative containing both within the optimum range is very efficient against wood-destroying fungi and insects and can be applied by injection in closed vessels or dipping in the open or painting with the solution. It can also be combined with other insecticides and fungicides or fire-proofing chemicals, provided the latter are present in small proportion, generally, less than 20 per cent.

A Preservative for Fruits and other Organic Bodies.

[P. Worthington and H. C. Webb, *Ind. Pat.*, 18108 of 1932.]

THE invention relates to the application of monovalent alkali salts of ichthyosulphonic acid (chiefly the ammonium salt termed ichthyol), to the preservation of fruit, particularly those of the citrus type, apples and tomatoes. The preservative, which renders the fruit highly resistant to fungus attack is best applied by dipping, spraying or brushing after admixture with a suitable carrier like petroleum jelly, glycerin, gelatin or vegetable gum. It is stated that the preservative does not detract from the edibility of the fruit as it is not substantially absorbed in the human alimentary system.

Science News.

SCIENTISTS in India will be gratified to read that Lt.-Col. R. B. Seymour Sewell, I.M.S., Director, Zoological Survey of India, has been requested to accept the post of Leader of an Oceanographical Expedition to the Arabian Sea. The Expedition is being sent out by the Cambridge University to investigate the area in the Arabian Sea from the Persian Gulf down to about the level of Madagascar and from east to west between India and Africa. The investigation will be specially carried out in reference to the zonation of the fauna on the continental slopes of the two sides between 50 and 1,000 fathoms, and the problem of the bottom deposits will also receive special attention. The Expedition will, as a result of its researches, be able to throw a definite light on the hypothetical Lemurian connection between Peninsular India and South Africa in the Palæozoic and earlier Mesozoic times.

* * *

The Muslim Association for the Advancement of Science was inaugurated at Aligarh in the early part of 1931, with the object of stimulating the spirit of original investigation amongst Mussalmans and of providing closer co-operation between Moslem scientists in different parts of India and elsewhere. The Association also undertakes the publication of *Proceedings*, somewhat on the lines of "*Chemical Reviews*", published by the American Chemical Society, containing summaries in specialized scientific fields by investigators who are engaged in active research work in these branches. The first volume of these *Proceedings*, which was published in December 1931, contained a long memoir by Professor R. F. Hunter on the work of his collaborators in the Thiazole Group during the last six or seven years.

The office-bearers of the Association are as follows: *President*, Nawab Masood Jung Bahadur, B.A., LL.D., Vice-Chancellor of the Muslim University; *Vice-Presidents*, Professors R. F. Hunter, D.Sc., Ph.D., D.I.C., and H. W. Blood Ryan, M.A., D.Sc., Ph.D., LL.D.; *Secretary*, Dr. M. Baber Mirza; *Council Members*, Drs. Syed Husain, A. A. Hyder, Rafique Ahmed, S. D. Muzaffer, S. Siddiqui, Professors Abdul Rahman Khan, R. Samuel and Mr. M. Haider Khan.

* * *

A few bronze medallions, struck by the South Indian Science Association, Bangalore, in commemoration of the Nobel Prize award to Sir C. V. Raman, are available from the Secretary at rupees two each.

* * *

Addressing the South Indian Science Association on the 19th August 1932, on "The Technique of Talkies", Dr. Lal C. Verman traced the development of the industry from the days of Edison's first crude attempt in 1913 to the modern talkie film. The essential principles of reproducing sound by the "sound on disc" and "sound on film" methods were described and the future lines of the development of this immensely popular and growing form of entertainment were outlined.

* * *

In a paper on "The Biological Values of Proteins from some Indian Food-stuffs", presented before the Society of Biological Chemists (India), on August 1932, Mr. N. Narayana explained the term Biological Value as defined by Thomas and later by Mitchell. After conducting experiments on rats with proteins from some ten Indian pulses, he found that their biological value varied from 57 to 78, while their digestibility varied from 58 to 83. *Cicer*

arietinum showed the highest biological value closely followed by Tuar dhal. On calculating from the figures for digestibility and biological value, the net protein value of these pulses was found to range from 10.43 per cent for *Dolichos biflorus* to 16.68 per cent for *Cicer arietinum*. On an average only about 50 to 60 per cent of the total protein of these pulses are available for the building up and repair of tissues in the body. There are serious limitations to the method of experiment for which possible remedies were suggested.

* * *

In a lecture entitled "Vegetable Ghee", Mr. P. Ramaswami Ayyar told the South Indian Association the essential factors of fats as food materials. His analysis of a large number of fats and oils and also attempts to synthesise vegetable ghee by hydrogenation led him to conclude that the "vegetable ghee" availabe in the market was, generally, a very poor substitute to genuine ghee and lacked in many essential nutritive factors, although a few kinds existed which nearly came up to the mark. Good oil was a better substitute than ghee when considered from the point of food value and nutrition. But taste comes in and so oil has its limitations. It should be possible to make a good vegetable ghee by mixing the correct quantity of oil, fatty acids and vitamin concentrates.

* * *

We have received a copy of Vol. I of the Bulletin of the Academy of Science of the United Provinces of Agra and Oudh, Allahabad. The Bulletin contains original papers in mathematics, physics, chemistry, botany and zoology, contributed by the members of the Academy, chiefly from the United Provinces. Full reports of the inaugural meeting when addresses were delivered by His Excellency Sir Malcolm Hailey, the Patron, and Dr. M. N. Saha, the President of the Academy, are also included at the end. There is a very interesting summary of Sir C. V. Raman's lecture on the Spin of Light delivered at the First Annual Meeting of the Academy. We welcome this interesting publication and hope that the Academy will continue to keep up its activities in the same high level as is shown in its first publication.

* * *

The University of Calcutta held an academic reception to Dr. Rabindranath Tagore on 6th August 1932, when Sir Hasan Suhrawardy, the Vice-Chancellor, welcomed the poet as "perhaps the most brilliant of the few persons who have made the culture of modern India understood and appreciated by the world at large". In a very touching reply Dr. Tagore said, "If in spite of my being a misfit, any connection has been established between me and our University, I feel I stand here on the side of the students to tell those who are young, that the strenuous course of their study and pride in their acquisition must never harden all that is delicate and living in their nature, their power of faith, of simple joy, and of sensitiveness to subtle touches of existence. It is fortunate to be able to acquire knowledge, but it is a rare privilege to be able to accept life in its varied significance, with unabated sympathy and interest untouched by cynicism and the coarse pride of cleverness."

* * *

Addressing the Annual Convocation of the Bombay University on the 16th August 1932, Sir C. V. Raman defined true scholarship as contrasted with scholasticism. He claimed science as a panacea for all ills—political, economic, communal, moral and spiritual. In a trenchant criticism of Indian Universities, he pleaded for an abolition of the present scholasticism practised by them and suggested a revolution in our educational outlook wherein the human spirit, intellect, and genius would manifest themselves at their highest.

* * *

A report in the *Hindu* says that the Cosmic Ray Expedition, which has been formed to study the Sun's rays at very high altitudes, comprising of Professor J. M. Benade (organizer and leader), Mr. Ross Wilson of the Foreman College Staff (Lahore) and Mr. R. K. Sharma, of the Ewing College Physics Department, which left Allahabad and Lahore last month, have reached Kulu, the first stage of the journey. The objective of the expedition is the high barren ridge near the shores of Tso Morari, a large brackish lake lying north-east of the Spiti valley and south-east of Lah and at an elevation of 15,000 feet above the sea-level.

From Karzok, a village on the western shores of Tso Morari, the expedition will attempt to reach an elevation of at least 20,000 feet, from which to make observations of the intensity of the Sun's rays. Originally, it appeared that the ridge of the west, with at least two peaks of over 20,000 feet, would best meet the conditions under which the observations are to be made, but information recently acquired at Kyelang from travellers who have visited the region of Tso Morari, gives reason to believe that the eastern ridge, with twin peaks of over 21,000 feet, will afford even better facilities.

The first stage of the journey to Manali in Kulu valley, the centre of the extensive fruit-growing industry of that valley, was accomplished by motor-lorry. From Manali, the expedition set out on foot with a train of 21 ponies, laden with the requisite scientific apparatus and supplies for six or seven weeks through little known country. Crossing Rotang Pass into Lahoul, the party set out on the most difficult part of its journey. They hope to reach Karzok shortly.

* * *

The Hon'ble Dewan Bahadur S. K. Reddiar's address delivered at the Madras Convocation is, as is usual on such occasions, full of mighty utterances. However, his conception of the requirements of representative Government and the adaptation of the educational system to meet them, is certainly original and we are reminded of the classification of mankind by Charles Lamb and later by Matthew Arnold. The educational system should be designed to produce three classes of peeple:—

(1) A wide Electorate hailing from the Elementary Schools.

(2) Representatives of the people in the legislatures produced by the Secondary Schools.

(3) A very small body of leaders who will be the creation of the Universities.

We have no doubt that there is great hope for Education in the reformed Constitution.

* * *

Prof. D. B. Blacklock, M.D., Professor of Parasitology, University of Liverpool, has put forward a very strong plea in the *British Medical Journal* for June 18, 1932, for the inclusion of Parasitology in the medical curriculum. Discussing the aim of the authorities responsible for the medical curricula, the author considers that the medical curriculum cannot be regarded as an exercise merely for the training of the mind without any idea of the immediate or future utility in reference to the training of medical graduates. The study of Parasitology, as he rightly points out, plays a very important part in the post-graduate experience of every medical practitioner, and the sooner he obtains an insight into realities of the existence of such parasites, the better equipped will he be to deal with those pathogenic organisms which are responsible for so many diseases of man. After enumerating the pathogenic parasites of man, belonging to the phylum Protozoa, Platyhelminthes and Nemathelminthes, the writer considers that utility should be the chief and almost the sole criterion of the value of the education given to the medical graduates. He very pertinently suggests that the question which a teacher of medical education in any branch should ask himself should be " 'How much of my subject will prove of real practical value to the student at any time?' not 'How much of my particular subject can I cram into this fellow in a given time?' " and he rightly concludes that the introduction of elementary Parasitology in the curriculum for the earlier years in the medical students' career would prove extremely useful. The knowledge that the students are studying something useful for their after-life will be a definite attraction, while the complicated and diverse life-histories of the human parasites would stimulate the imagination of the students and develop powers of observation and reasoning to such an extent as to give them a vital interest in the study of Zoology. We believe that the authorities responsible for the medical education in different places in India would do well to study Prof. Blacklock's article and adopt the major part of his suggestions.

B. P.

Reviews.

The Life Line of the Thyroid Gland. By Col. R. McCarrison and Prof. K. B. Madhava. Thacker Spink & Co., Calcutta, 1932.

The problem of the causation of the enlargement of the thyroid gland, which we call 'goitre', is one of the most difficult as well as one of the most fascinating in the whole range of Medical Research. Since the time of Hippocrates theory has followed theory in attempts to explain it. Yet, strange as it may seem, there has hitherto been little attempt to define the normal limits of the thyroid gland's size. It is true that figures purporting to represent the normal weight of the organ in different races are to be found in text-books and monographs dealing with disorders of the gland, but these are not, as a rule, expressed in terms relative to some other readily obtainable body measurement; so when we are told that the normal weight of the gland lies between 20 and 60 grammes in man, and rather more in women, we are at a loss to know whether a gland weighing, say, 60 grammes in a person of 16 stone would be within normal limits were it to be found in a person weighing ten. Furthermore, we derive the impression that the organ is normally larger in females than in males; an impression which may require some qualification. A few observers have given the normal weight of the gland in terms of body-weight: Marine, for instance, has stated that the upper limit of the normal weight is 0.35 gm. per kilogramme of body-weight. But such an estimate, though it may possibly be accurate enough at one period of life, does not allow for the possibility that it may vary at different periods and under different conditions of life and yet be normal. In short, the question, "What is the normal size of the thyroid gland?", is one that calls for answer as urgently as does the other one, "What is the cause of the thyroid gland's enlargement?" Indeed, it is impossible accurately to answer the latter until an accurate answer to the former has been given. R. McCarrison and K. B. Madhava have in their recently published *Memoir*, "The Life Line of the Thyroid Gland", attempted to answer both these questions. In this attempt they have brought the biometric to the aid of the experimental method of investigation; a combination which is a happy one.

Colonel McCarrison, whose researches on 'Goitre' are well known to all students of this subject, has provided the extensive experimental data which his colleague, Professor Madhava, has subjected to the closest statistical scrutiny, with results which throw a flood of light on many dark places in the ætiology of Goitre. The biometric method has provided a ready means of determining the normal size of the thyroid gland and the normal range of its variation in size; and of estimating with accuracy the degree of its departure

from normal and the effect of agencies which cause it to increase or to diminish in size to an abnormal extent. This method of detecting departures from the normal size of the gland has a greater precision than the histological study of the gland itself; for in its detailed structure the organ normally varies within the widest limits, and without an accurate knowledge of the gland's normal range of variation in size, extremes of histological variation may lead to the description of normal conditions as pathological. Precise means of estimating the gland's size are thus an essential adjunct to the histological study of an organ which at one time may be empty of colloid and at another filled with it, depending on the needs of the body for thyro-globulin.

The authors have used data provided by different species of animals—rats, guinea-pigs, rabbits, monkeys and pigeons—living under strictly controlled experimental conditions; and the similarity of their findings in the several species of the lower animals affords reasonable grounds for the assumption that these findings are, in general, applicable to man—the more so as the physiological attributes of this remarkable organ are the same in all vertebrates.

It is impossible in the space at our disposal to do more than refer to the more outstanding of the conclusions drawn by the authors of this *Memoir*. They have shown that in early life, before the attainment of the individual to sexual maturity, the thyroid gland normally grows at a greater rate than the body as a whole. It attains to its maximum weight relative to that of the body just prior to the period which corresponds in animals to puberty in man; thereafter its relative size gradually diminishes in both sexes, remaining at a relatively low level in males but exhibiting in females secondary rises associated with reproductive activity. The organ thus follows—from the point of view of size—a definite course throughout life. This course the authors have designated, "The Life Line of the Thyroid Gland", and they have employed this designation as the title of their *Memoir*. They point out that because of the gland's conspicuous position in the neck its relatively larger size in childhood may be mistaken for 'goitre' when, in the vast majority of children, it may be nothing more than the normal expression of the organ's place in the bodily economy. In support of this assertion the results of 'goitre-surveys' in school-children are contrasted with similar surveys in animals that have lived under strictly controlled conditions in the laboratory, and the size of whose thyroids have been acucrately determined after death while at the same time the histological changes associated with abnormal increase in size of the organ have been determined microscopically. They indicate the statistical criteria on which the gland's departure from normal size may be gauged; they discuss the influence of such factors as season, sex, sexual activity, sanitary condition and diet on the life-line of the organ and the relationship of iodine to it—indicating the importance of this element as an antigoitrogenic agent while at the same time defining its limitations so far as their data permit them to do so. An interesting chapter is that devoted to the statistical scrutiny of the results of certain surveys of goitre in school-children; there it is made clear that without such scrutiny and without reliable criteria for the detection of departures from a normal size, erroneous conclusions may be drawn. Finally, they classify the known goitrogenic agents into two groups: dietetic and hygienic. In the former group they include excesses of certain substances in the diet—fats, fatty acids and lime, deficiencies of certain substances in the diet—vitamin A, vitamin C, iodine and phosphates, and the presence of certain goitre-producing substances of an unknown nature in some food materials, such as cabbage, some cereal grains and ground-nuts. In the latter group they include insanitary conditions of life and, by inference, infection. It is of great interest to note that insanitary condition even of a gross kind does not cause goitre unless the food be ill-constituted; the dietetic factor combining with the unhygienic induces the maximum goitrogenic action. Obviously, the 'causation of goitre' is not merely a question of deficient intake of iodine but involves factors which bring about a relative deficiency of this element—so important in thyroid function—and others that are unrelated to deficiency of iodine, either of an absolute or of a relative kind; the latter appear to be related to impairment of the gland's functional capacity rendering it susceptible to attack by unknown agents, probably toxic or microbic; and, presumably also, impairing its ability to deal with the iodine that is ingested and absorbed into the system.

No doubt the authors would themselves agree that this work does not tell the whole story either of the gland's normal activities so far as size is concerned, nor of the factors which cause it to depart from a normal size; but as an attempt to introduce order into the chaos which surrounds the subject of goitre, this *Memoir* is a notable achievement and an important contribution to Biometric as well as to Medical Science.

* * *

In a small pamphlet received by the last mail, Lt.-Col. J. Stephenson gives '*A Short Historical Survey of the Annals and Magazine of Natural History from* 1828 *to* 1932.' This historical sketch of one of the foremost zoological journals is of special interest, for it directs our attention to its chequered career since its inception in May 1828, to the illustrious contributors to its pages and to the great and noble rôle it has played in the development of human thought and in the dissemination of knowledge concerning Natural History subjects. The scope of the *Annals* was very wide in the beginning as it included Zoology, Botany, Mineralogy and Meteorology, but soon after 1878 the journal came to consist, as at present, of Zoology and Palæontology. In later years when the scope of Zoology became wider and specialization became necessary for the different branches of this science, other journals sprang up so that the scope of the *Annals* came to be largely restricted to Systematic Zoology (including Palæontology). Systematic Zoology forms the bedrock on which all other zoological research ultimately rests, and the *Annals* in its present rôle is a storehouse of this essential knowledge. It is gratifying, therefore, that the Publishers, Messers. Taylor and Francis, Red Lion Court, Fleet Street, London, E. C. 4, are now offering a limited number of complete sets of *The Annals and Magazine of Natural History* (1838-1931) in 188 volumes at a special price of £210 net.

S. L. H.

Coming Events.

Twentieth Indian Science Congress.

The Twentieth Annual Meeting of the Indian Science Congress will be held in Patna from January 2nd to 7th, 1933.

His Excellency Sir James David Sifton, K.C.I.E., C.S.I., C.I.E., B.A., I.C.S., Governor of Behar and Orissa, has consented to be Patron of the Meeting.

OFFICERS OF THE TWENTIETH CONGRESS.

President:

Dr. L. L. Fermor, O.B.E., D.Sc. (London), A.R.S.M., F.G.S., M.Inst.M.M., F.A.S.B., Director, Geological Survey of India, Indian Museum, *Calcutta.*

Sectional Presidents:

1. AGRICULTURE.—M. Afzal Husain, Esq., M.A. (Cantab.), M.Sc., I.A.S., Locust Research Entomologist to the Government of the Punjab, The Punjab Agricultural College, *Lyallpur, Punjab.*
2. MATHEMATICS AND PHYSICS.—Dr. A. L. Narayan, M.A., D.Sc., Meteorologist, *Kodaikanal, South India.*
3. CHEMISTRY.—Dr. Panchanan Neogi, M.A., Ph.D., I.E.S., Professor of Chemistry, Presidency College, *Calcutta.*
4. ZOOLOGY.—R. Gopala Aiyar, Esq., M.A., M.Sc., Additional Professor of Zoology, Presidency College, and Honorary Director, Madras University Zoological Laboratory, Presidency College, *Madras.*
5. BOTANY.—Dr. S. L. Ghose, M.Sc., Ph.D., F.L.S., Department of Botany, Government College, *Lahore.*
6. GEOLOGY.—Prof. N. P. Gandhi, M.A., B.Sc., A.R.S.M., A.I.M.M., F.G.S., D.I.C., Professor of Mining and Metallurgy, Engineering College, Hindu University, *Benares.*
7. MEDICAL AND VETERINARY RESEARCH.—Lt.-Col. A. D. Stewart, M.B., D.P.H., D.T.M. & H., F.R.C.S.E., I.M.S., Director, All-India Institute of Hygiene and Public Health, *Calcutta*, and Professor of Hygiene, Calcutta School of Tropical Medicine and Hygiene, 21, Chittaranjan Avenue, *Calcutta.*
8. ANTHROPOLOGY.—Dr. Panchanan Mitra, M.A., Ph.D., Professor of Anthropology, Calcutta University, *Calcutta.*
9. PSYCHOLOGY.—Dr. Girindrasekhara Bose, M.D., University College of Science and Technology, 92, Upper Circular Road, *Calcutta.*

The Local Secretaries will be Dr. K. S. Caldwell, M.A., B.Sc., Ph.D., F.I.C., F.C.S., I.E.S., Principal, Science College, *Patna*, and Prof. Kamta Prashad, B.A., I.E.S., Professor of Physics, Science College, *Patna*, to whom all enquiries as to accommodation should be addressed.

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South Indian Science Association, Bangalore.

(CHEMISTRY LECTURE THEATRE, CENTRAL COLLEGE.)

Friday, 21st October, 1932, at 6-30 P.M.

'Liquid Air', by Mr. G. Gundu Rao, Indian Institute of Science, Bangalore.